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ABSTRACT

This collection of commissioned papers provides a variety of perspectives on the impact of global information networks. The following articles are included: "The Promise of Global Networks: An Introduction" (Jorge Reina Schement); "Architecture and Expectations: Networks of the World--Unite!" (Marjory S. Blumenthal); "The Regulation of Global Networks: A European Perspective" (Luigi Prosperetti); "The Internet in the Other Three-Quarters of the World" (Bella Mody); "Business on the Net: A Primer on New Realities" (Richard D. Taylor); "How Will Work Change? E-Lancers, Empowerment and Guilds" (Thomas W. Malone and Robert J. Laubacher); "Global Networks Toward New Communities" (John D. H. Downing); and "Cybercrime, Cyberterrorism, and Network Warfare" (John M. Fabry). A brief profile of each author is provided. Individual papers contain endnotes. (AEF)

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THE PROMISE OF GLOBAL NETWORKS

1999

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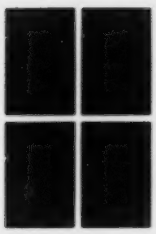

THE PROMISE OF GLOBAL NETWORKS

1999

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Institute for Information Studies

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The Institute for Information Studies (IIS) was established in 1987 by Nortel Networks and The Aspen Institute, an international center for the study of leadership and public policy and their impact on corporations, individuals, communities, and society in general. Each year the IIS publishes an *Annual Review,* which is a collection of commissioned papers that provide a variety of perspectives on a particular topic relating to the impact of communications and information technology.

The IIS and the *Annual Review* operate under the general direction of Charles M. Firestone, Executive Vice President, The Aspen Institute, and Director, IIS. The 1999 Annual Review was prepared under the editorial direction of Jorge Reina Schement, Professor of Communications and Information Policy, The Pennsylvania State University.

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5

THE PROMISE OF GLOBAL NETWORKS: AN INTRODUCTION

The new electronic interdependence recreates the world in the image of a global village.

—Marshall Herbert McLuhan[1]

Marshall McLuhan provided the first generalized vision of the Information Age to come when, in 1962, he introduced the metaphor of a "global village" to describe society in the Television Age. McLuhan's first sortie, *The Gutenberg Galaxy*, envisioned a new kind of society in which viewers from all corners of the globe would one day stand united in front of the common images brought to them by their set-top boxes.[2] The notion of a global village is as compelling today in the Information Age as when the term was first coined—a tribute to McLuhan the sage.

In 1964, McLuhan published *Understanding Media*, a book that would contextualize the study of communications for a generation. In a chapter titled "The Medium Is the Message"—which would become another catch phrase—McLuhan distills communications into its two basic elements: content and transmission.[3] Transmission media are not merely neutral infrastructure through which communication passes, McLuhan argues; rather, they—in their own right—radically condition both the way people communicate and the meaning of what is communicated. Indeed, content plays a nominal, auxiliary role to transmission media in the action of conveying messages.[4] A quarter of a century after publication of the book, McLuhan's argument carries new weight in connection with the Internet, a medium that compresses time and space and enables people to expand communications in new, rich ways. For many

people, the content that they can send, receive, or retrieve through the Internet is less awe-inspiring than the globally ubiquitous network that carries its bits: the marvel of the Internet is the medium itself.

In 1967, McLuhan—along with now forgotten co-author Quentin Fiore—published *The Medium Is the Massage.* This book, whose title is a play on words of the earlier catch phrase, was a primer to the Information Age for college students of the late sixties. With this book—constructed in multiple perspectives through pictures, optical illusions, and a few words—McLuhan urges a key point: communications in the "Mass Age" is a fuzzy concept that senders and receivers can "massage" in many ways in order to create or derive meaning. Though McLuhan's original work was written about the Television Age, its chaotic organization, jarring format, and multiple levels of meaning seem a fitting introduction to the Information Age. Moreover, as the line between transmission and content begins to blur and as multiple mediums compete for primacy, we—as individuals and as a collective society—need to find new meaningful distinctions by which to understand and process conflicting messages. It may not be a coincidence that the "founding fathers" of the Internet, many of whom were students in the sixties, created a new medium that allows for greater massage in communications.

In the tradition of Marshall McLuhan, the 1999 *Annual Review* of the Institute of Information Studies stimulates us to imagine the tremendous dynamics and consequences that result from the emergence of global networks. In this volume, Marjory Blumenthal explains how decisions about Internet architecture have affected its growth and development. Luigi Prosperetti shows that different political and regulatory approaches to promoting electronic commerce ("e-commerce") in the United States and Europe have yielded strikingly divergent outcomes. Bella Mody highlights the fundamental differences that distinguish Internet proliferation in developed and developing countries. Richard Taylor explores the importance of e-commerce in the U.S. economy and explains why business leaders should—and how they can—enter this emerging market. Thomas Malone and Richard Laubacher examine how sweeping changes in information technology may enable society to establish new patterns of work. John Downing uses the idea of community to suggest a reassessment of our notions of the Internet. John Fabry illustrates how ubiquity and openness (which other writers

acknowledge largely in positive terms) leave networked systems vulnerable to criminal activity, terrorism, and information warfare.

Taken together, these seven perspectives offer a road map of a terrain that ranges from architecture to European regulation to conditions in developing countries to electronic commerce to work to community to information warfare and security. Perhaps it is symptomatic of our time that no single global vision of telecommunications predominates. Depending upon the arena, these discourses focus on engineering challenges, business plans, economic models, and/or political constraints. Just as we are and should be concerned with the disposition of the network, we are drawn to conjecture over its consequences.

***

Marjory S. Blumenthal begins *The Promise of Global Networks* with a comprehensive survey of global networking architecture and the Internet. In "Architecture and Expectations: Networks of the World—Unite!" Blumenthal demonstrates that the future of the Internet as a common architecture for global networking is not inevitable; it will depend on the resolution of debates over standards and bandwidth as well as on choices to be made regarding constraints on access. Building the next generation of the Internet will not come easily. One issue is the problem of scale that is increasingly challenging the research community. Another is the question of management and governance facing the corporate and government sectors as the Internet continues to grow. A third issue is the continuing development of the Internet, which began through a series of agreements and experimental projects, but will be shaped in the future by market and competitive forces. Beyond these factors, an analysis of the Internet must also reckon with the unpredictability of human behavior. Although the body of examples of innovative uses of the Internet continues to grow, little is yet known of the social and cultural impacts set in motion by its diffusion. Just in the area of privacy, for example, the pattern set highlights both threats and opportunities (without even taking into consideration the multiple meanings of privacy across cultures). Ultimately, the challenge will be to create a discourse capable of offering technical feasibility, political reality, and open access.

Luigi Prosperetti's essay, "The Regulation of Global Networks: A European Perspective," underscores the fact that the emerging global network arrives unaccompanied by a single vision. Prosperetti discusses the different approaches taken by the United States and the European Union (EU) in promoting the development of global networks. Like the United States, the EU has committed its resources to the development of a Global Information Society (GIS).[5] However, infrastructure development in Europe has been considered the primary responsibility of the public sector—in contrast to the United States, where the expectation has been that the private sector will lead. That is, Europeans seek to manage what Americans take for granted. The European tradition encourages deliberation and more cautious engagement. In consequence, European deployment of Internet backbone lags behind deployment in the United States (as does household penetration of personal computers). Of particular concern is the lag in e-commerce. Whereas Americans have pushed especially for the enhancement of the information infrastructure for electronic commerce, and have set out to build trust among users and consumers, European policy decisions have left the EU at a disadvantage. However, Prosperetti suggests that the gap is temporary; already, e-commerce in financial services is picking up on the European side. In addition, among regulators and policymakers, an attitude seems to be emerging that embraces speedy "second-best" solutions to problems, rather than time-consuming searches for the best answer. This willingness to accept some lack of clarity in the overall interest of market growth may be new to Europeans, but it proves their adaptability and their willingness to compete.

In "The Internet in the Other Three-Quarters of the World," Bella Mody doles out reality of a kind that technological enthusiasts often ignore but should take to heart. She reminds us that three-quarters of the world's population live in developing countries, where the average person consumes 814 kilowatt-hours per year, compared to the nearly 8,000 consumed by the average person in industrial countries. About 50 percent of the people in the developing world have never made a phone call, compared to the industrialized countries—where roughly 80 percent of the people have phones in their homes. There are 6.5 personal computers for every 1,000 people in the developing world, compared to 156 on the other side of the great divide. And, though we herald the Internet as a global system, in developing countries fewer than 1 person

in 1,000 has access to it. What's more, access is only a part of the picture. Even if access to the Internet were widespread in developing countries, users there have unique needs based not only on micro consumption patterns but also on large-scale economic, political, and cultural forces within their respective nations. Mody cautions us against hoisting unrealistic expectations on the Internet in developing countries. If McLuhan's metaphorical village is ever to achieve its promise in reality, then a challenge, however daunting, beckons us. Indeed, it has beckoned us for half a century, five decades in which governments and other groups have applied first radio, then television, then satellites, and now computers to the aim of reducing poverty and raising the quality of life. The result: no victory yet. The lesson: in order to build an Internet-enabled economy in the developing world, unique obstacles must be met and overcome. If these cautions sober our expectations that we will soon see the swift arrival of a global Internet for all, then Mody's careful dose of reality may be worth taking. In a volume such as this one, her essay sets an indispensable context.

In one of the conceits of our anticipatory age, we describe markets as "emerging." We allow ourselves to imagine that markets are inherent in nature and waiting to be discovered like some deserted island or previously undetected comet. When they are discovered, perhaps rising out of the sea or hurtling into view, we scramble to capture the new territory. All the while, we hold a high comfort level with this powerful metaphor because it assures us of the heroic nature of market forces; after all, if we haven't struck it rich, it must be that we lack the touch of the entrepreneur/explorer. Now comes Richard D. Taylor to modify the metaphor, in his essay "Business on the Net: A Primer on the New Realities." Taylor reminds us that the framework for a market is coming into view. The market itself is there to be developed with elbow grease and ingenuity in roughly equal parts. Thus the goal of Taylor's essay—to provide a primer on e-commerce by describing the conditions and determinants behind the opportunities–is especially timely. He points to three principal preconditions that set the stage for Internet-based markets: first, the lowering of international trade barriers, especially for information technologies, telecommunications, and financial services; second, freely flowing capital in search of profits around the world; and third, of course, the Internet itself. Where Prosperetti suggests why Europe lags behind, Taylor suggests why the United States has surged ahead. Even so, to create and enter an Internet-based market can be an

expensive proposition involving enterprise software systems costing millions in consulting and license fees. Yet, if the costs seem daunting, the value of the market is stunning. Tracking firms estimate the business-to-business market alone at $30 billion last year and growing to nearly 200 billion next year. For businesses, the future holds promise and peril, though it is the promise that will drive the growth of e-commerce.

The arrival of a global information economy heralds profound changes in the nature of work. Yet, incontestable though we might find the preceding statement, understanding—even describing—the new era proves a difficult assignment. Accordingly, the question posed by Thomas W. Malone and Robert J. Laubacher's "How Will Work Change? E-Lancers, Empowerment, and Guilds," offers a clue to the shift in those fundamental forces that shape the characteristics of work. For some time, corporations have been adapting to a logic educed from two observations: innovations in information technologies (IT) decrease communication costs; and, the advantages extracted from new IT often arrive with the need for even more communications. A central tendency will be the growing importance of autonomous players working autonomously as independent contractors; these are Malone and Laubacher's "e-lancers," working through networks in ad hoc assemblages concentrating on a task or project. The shape of organizations will become more open, flexible, and opportunistic. In fact, the move in the 1990s toward alliances and partnerships reflects this adaptation. What then of the worker who must shift and hoof it to stay competitive, to minimize employment discontinuities, and to maintain a standard of living? Here Malone and Laubacher proffer an original proposal. Recognizing that legions of independent e-lancers will develop needs ranging from the common to the idiosyncratic, the authors see the opportunity for an organization whose function is to meet needs—a model: the Screen Actors Guild. In a sense, the time is ripe; the growing numbers of e-lancers create the conditions favorable to the establishment of Information Age guilds. In the final analysis, the lesson of this essay reaches outside e-lancers and guilds. As society makes its way through the foothills of new era, we must demand new thinking of ourselves—thinking that frees us to seize new possibilities.

In "Global Networks Toward New Communities," John Downing tackles one of the most perplexing intellectual riddles of our age. In this essay, he asks "What is community?" Most of us are prepared to assert

the reality of new communities emerging through electronic networks, especially the Internet. Yet, at the same time, we continue to adhere to nineteenth-century notions of a place where face-to-face human interactions prevail and interdependence produces social capital. This vision of community—a vision that serves as a benchmark for most of us—contains a cluster of common elements: a place (e.g., village) where everyone knows everyone; solidarity in the face of threat; a sense of rootedness in geographic place; a dense, even timeless, network of social relationships; a place where politics is local and democracy prevails; and a place where people depend on each other. Within this ideal, we imagine the world we would want to bequeath to our children. Yet that same milieu can produce, as Downing reminds us, the suffocating hostility of long-remembered wrongs and the icy silences that travel across generations. After all, in the history of American urbanization, the realities of small-town relationships provided the push while the glitter of the cities provided the pull. Between these poles lies a complex phenomenon essential to the existence of any society. In parsing this phenomenon, Downing makes his great contribution. He is especially timely, since we now see the emergence of groupings of people that transcend geography coupled with a tendency for the members to declare themselves communities. So powerful a metaphor does community render, that conferring the label "community" to a user group assures us of social value and goodness. Here Downing raises a bold cautionary hand: "In the end, to apply the term 'Internet community' as though it had a single meaning to such widely disparate groups as Blacksburg car owners, Uyghur nationalists, Punjabis segregated from each other by an artificial political frontier, TV program fans, and Americans trying to come to terms with 'race,' does extreme violence to the variety of meanings of community—quite apart from deifying the Internet as a technical alchemy." That such groups will continue to proliferate is accepted as an immutable feature of the Internet; what places they will find in the weave of society remains to be understood.

Col. John M. Fabry's essay, "Cybercrime, Cyberterrorism, and Network Warfare: The Next Generation of Concerns for Users of Networked Information Systems," confronts the dark side of the Internet. Global networks, we now acknowledge, come with an Achilles' heel. Their very ubiquitousness and openness offer opportunities for sabotage at nearly every node and link along the chain.

Moreover, the threat is real. The director of one of the nation's largest university laboratories has admitted to me in private the regular occurrence of several weekly break-ins to the lab's computer system. And, he maintains, his lab is not unique in this undesired claim. If so, then from where do these threats emerge? Originally, networks experienced disruptions as a result of their early fragility. Similarly, early spoofing, password sniffing, and adolescent hacking contributed to the headaches of network administrators, even though much of it was harmless. In recent years, however, the severity of the threat has ratcheted up. At this writing, the cyberworld is experiencing the Melissa and Papa e-mail viruses and Serbian "bombardment" of the NATO Web site—all in a single week. Fabry identifies three primary sources of network threat to be faced in the twenty-first century. Perhaps the most pervasive will be cybercrime. Threats to information-as-property (e.g., wire fraud and interstate transport, theft of information services and trade secrets, electronic trespass, electronic invasion of privacy, and destruction or alteration of property that exists only in electronic form) severely challenge the law-enforcement establishment; as cybercrime also becomes organized crime, the stakes are likely to go up. Cyberterrorism pushes the category of threat beyond the type of menace aimed at property and personal safety to that which may compromise national security. In this zone, conceivably, where perpetrators may come without any connection to a hostile state and may be obscure in goal and membership, will lie the deadliest threat. Yet still beyond is subversion of networked systems into an arena for warfare. After all, the information infrastructure of any nation, or group of nations, constitutes a valuable military asset. Consequently, its military value alone marks it as a likely target in time of hostilities, while its inherent vulnerability makes it additionally attractive. Cryptography, deception, illusions, targeted software viruses and worms, bombing campaigns aimed at the telecommunications network, and satellite reconnaissance comprise some of the arrows in a new quiver available to militaries and politicians. Given the successful use of similar weapons in the wars of this century, it is little wonder that "network warfare" is emerging as a theater of operations. In the century arriving, international stability may depend on new forms of information-centered détente.

Within the visions of global villages and networks that dance in our heads, the promise of international stability beckons us like a siren. After all, having narrowly survived a century of unimaginable carnage, we want to believe that the new age offers peace. To buy that peace by girding the world with global information networks seems fitting. Yet, if the new networks are to promise peace, what must change? The theme of globalism, with its strands of global commerce and world-wide community, implies a world order beyond the nation-state. To some, it seems that old geographic boundaries hold less validity today than ever before; but, if so, then what will constitute sovereignty and who will impose it? Perhaps these global networks, which will surely look primitive to our great grandchildren, are the first indicators of a profound change in political and economic organization. That the visible future holds no clarity on this question troubles me not one whit. For what is certain is that we will encounter many forks in the road along the way. Some, as Fabry warns us, are best untraveled; others, like those described by Mody, we have traveled before and must travel again. Here, indeed, we have a road map for our journey.

As always, the *Annual Review* brings diverse perspectives together and takes the reader beyond the conventional imagination. The seven perspectives offered here underscore the many strands now weaving a global network. The more we see, the more we marvel. Nevertheless, let us beware the magnet of our fascinations. The Internet has captured our imagination; and so, not surprisingly, it mirrors our aspirations. That we should imagine its globalism, even when large portions of the earth's population remain illiterate and without access to a telephone, testifies to our fascination with the idea of a world system. Thus, we let our visions guide us; and, as they do, let us follow with a sense of humility and responsibility.

Jorge Reina Schement
Professor of Communications and Information Policy
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April 1999

ENDNOTES

1. Marshall McLuhan and Quentin Fiore, *The Medium Is the Massage* (New York: Bantam, 1967).

2. Marshall McLuhan, *The Gutenberg Galaxy: The Making of Typographic Man* (Toronto: University of Toronto Press, 1962), 69, 101.

3. Marshall McLuhan, "The Medium Is the Message" in *Understanding Media: The Extensions of Man* (New York: McGraw-Hill, 1964), 7–21.

4. Most scholars agree that McLuhan derived his ideas from those of his mentor, Harold Innis. Innis was a graduate of the University of Chicago, where he studied under Robert Ezra Park and was influenced by the work of Siegfried Giedion. Park's and Giedion's views on technology strongly influenced Innis, contributing to the element of technological determinism in Innis's writings, and later to that in McLuhan's. See, e.g., Siegfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (New York: W. W. Norton, 1948); and Robert Ezra Park, "The City: Suggestions for the Investigation of Human Behavior in the Urban Environment," *American Journal of Sociology* 20 (1916): 577–612. Yet better than his mentors, McLuhan dazzles the reader with visual images. He can capture the essence of a medium in a single phrase, as he does by describing the clock as "the scent of time," the automobile as "the mechanical bride," and radio as "the tribal drum." His narratives captivate the reader and form lingering images, as in this delicious distillation of the message in the medium, ". . . the 'content' of a medium is like the juicy piece of meat carried by the burglar to distract the watchdog of the mind" (*Understanding Media*, 18).

5. Terms are just words; yet, they mean everything. What emerges in American policy discourse as the National Information Infrastructure (NII), with its connotation of nationhood and hardware, becomes in Europe the Global Information Society (GIS), carrying the implication of international cooperation and public value. A brief consideration of the underlying assumptions of these two concepts suggests why American-European negotiations do not always proceed smoothly.

ARCHITECTURE AND EXPECTATIONS: NETWORKS OF THE WORLD—UNITE!

Marjory S. Blumenthal

Executive Director
Computer Science and Telecommunications Board
National Research Council

The surest test of the civilization of a people—at least, as sure as any—afforded by mechanical art is to be found in their architecture, which presents so noble a field for the display of the grand and the beautiful, and which, at the same time, is so intimately connected with the essential comforts of life.

—William Hickling Prescott
The Conquest of Peru (1847)

I. INTRODUCTION

A new vision of global networking architecture, framed by the always-international Internet, is emerging—a vision that holds the promise that "global networking" may no longer be an oxymoron. As measured by where people may call to or from, networking has long been international, if far less than global. Decades of defining communications as telephone service have witnessed sluggish growth in teledensity in the developing world, where there may be fewer than 10 and typically well under 50 phones per 100 people, as compared to numbers closer to 100 in developed nations. Penetration of television

has grown faster but remains low in those regions.[1] The magnitude of the gap in network access between developed and developing countries suggests that even the sustained high rates of growth now in evidence (due to relaxed regulation and increased competition) will yield limited progress for the foreseeable future.

How can it be other than science fiction to suggest that an approach to networking that appears to demand *more* technology and know-how than telephony can improve the global situation? After all, even the forecasts predicting several hundred million Internet-connected people worldwide by the early 2000s[2] still guarantee—in this world of *billions* of people—that personal access will be far from ubiquitous for the foreseeable future. Nonetheless, the Internet does promise to lessen communication's current status as the privilege of a global minority. A technology built on principles of sharing, the Internet is already stimulating communal access in areas starved for telecommunications, and its synergy with telephony and other network deployment is expanding personal access in others.

Progress will be shaped by interactions among technology, economics, and public policy, interactions that are hard to predict. (See Box 1.) Optimists note that such interactions have yielded the World Wide Web, the flourishing of (early) electronic commerce, and substantial investments in wireless and other communications. Pessimists counter that those investments have not gone far enough, that they have vested more interests and motivated more political activity, that they do not touch the lives of the non-information-centric, and that they are susceptible to global economic slowdown. Both views share the recognition that expanding service to more of those who are hard to serve hinges on making the Internet more usable and more useful, a result that itself hinges on improving the technology. In this argument, the optimists can win, thanks to the features and adaptability of the technology.

Regardless of outlook, technology is only part of the picture. As people around the world pursue the goal of communications and information anytime, anywhere, by anybody, issues for the future relate to the challenge of living with more communications and information technology in addition to the challenge of broadening access. It now falls to individual nations to develop public policy for this networked future. This process must now become more of a joint enterprise,

because global networking gives rise to global society—a concept easier to label than to understand or guide.

This chapter discusses a vision for global networking architecture that arises from the Internet. The term "architecture" is used in the computer-science sense to refer to a framework of functions or components and their logical relationships and interfaces; it can be contrasted to "topology," which refers to the physical arrangement of network facilities. This chapter argues that because of its architecture, the Internet has catalyzed global networking and global network evolution. The Internet can continue to foster global networking if the forces of public policy and private control are channeled in ways that preserve the Internet's virtues as it evolves. Section II begins the discussion by describing at a high level the nature and evolution of Internet technology. It explains why the Internet has worked and can continue to work as the architecture for global networking despite becoming a commercial and multi-market set of services. Section III takes a bottom-up look at key trends in global networks, outlining international variation in deployment and use of networks.[3] These communications infrastructures, which underlie the Internet, are shaped directly by the forces of investment and telecommunications regulation—they are the reality against which the Internet vision plays out, the means through which people around the world experience global networking.

Section IV addresses the evolution of the Internet. First it characterizes the technical challenges and prospects associated with growth in volume and kind of use. Then it arrays the spectrum of institutional forces that shape how the technical options are developed and implemented. It provides a transition from consideration of capabilities to consideration of their ramifications. Section V explores what it means to live with global networking. It draws from experience with the Internet so far to anticipate impacts on people and how those impacts will feed future evolution of global networking. The chapter concludes by underscoring the circular relationship among the Internet, its architecture, and the nature of global networks. It relates the future of global networking to the shifting balance of power resulting from the rise of issues relating to network use. These issues must be addressed by governments, private organizations, and individuals to achieve the vision of global networking.

Box 1: Toward Global Information Infrastructure

The Internet has helped to broaden discussion from communications networks to information infrastructure: national information infrastructure (NII), global information infrastructure (GII), and variations on those themes. The "information" label refers to the blending of technology for both communications and information.[4] It expands the networking focus beyond communications networks per se. The information element also introduces new players, business models, and issues to the comparatively narrower set associated with conventional telecommunications.[5] In the developing world, these are linked to support for economic development; in the developed world, they are associated more with shifts in the business landscape. Information capability attracts arguments about what is in the public interest and how to reconcile competing private interests, as epitomized by international privacy debates and contemplation of social and economic gaps between so-called information haves and have-nots. These and related issues influence incentives for investing in communications networks.

The infrastructure label suggests comprehensive assimilation of networks (and information technology generally) into the economy and society. Assimilation is the proverbial two-edged sword: it tantalizes many, but achieving it remains a challenge, both in developed nations with advanced technology and know-how and developing nations with subsistence or growing economies. In both developing and developed countries, regional economic development has been linked to information infrastructure; pan-European and pan-African programs epitomize this trend.[6] Assimilation depends on having successful and affordable applications that feed forward and backward into network development. It drives the European Commission's new Information Society Technologies Programme[7] and the African Information Society Initiative,[8] for example, and programs in countries and nongovernmental organizations around the world that attempt to leverage information technology development and use to improve standards of living.[9] Assimilation has

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side effects: it raises questions about dependability, management, and control, echoing those seen in conventional utilities. This set of concerns has been captured in the fin de siècle attention to critical infrastructure in the United States, which is linked to national security and law enforcement, both international in dimension.

The national and global labels emphasize the objective of breadth (universality) of both access and use. In general, developed nations have more of both bandwidth and access, and the United States appears to many outside the country to have the most of all, given high teledensity and growing availability of higher-bandwidth service. Of course, such generalizations mask important variation. All countries confront access disparities associated with uneven distribution of income and population—more densely populated and higher-income areas are best served—and areas with difficult geography. A result is international attention to rural service, access by small- and medium-sized enterprises, and service for low-income populations. Government policies and programs and nongovernmental organizations act to promote broader access, with uneven success.[10] Singapore, for example, has installed substantial fiber capacity only to find use constrained by problems of affordability and appeal.[11] Finally, the national and global labels give rise to a widening range of policy interventions, as the potential for broad access and impact grows.

II. IF "ARCHITECTURE" IS THE QUESTION, IS "INTERNET" THE ANSWER?

If the Internet continues on its trajectory as an integrating framework for global communications, then the Internet's architecture will become the architecture of the evolving global network. This section explains why the Internet is fundamentally integrative and how it supports broad scope in communications services and their use. It outlines how the Internet makes use of different kinds of communications networks (and devices) and how it interconnects different networks.

The Internet: Bit By Bit

At its most basic level, the Internet uses telecommunications channels relatively efficiently by breaking up what is communicated ("information") into smaller pieces that can be combined from users who share communications capacity. In a given transmission across the Internet, a sending system breaks information into pieces, encoding and (in essence) labeling the pieces in specific formats that enable them to move from sender to receiver; at the other end of the process, a receiving system reassembles the pieces. The pieces are called "packets"; the approach, "packet switching"; and the sending and receiving systems, "hosts."[12] The fragmentation involved in packet switching allows the resulting packets transmitted over the Internet to travel to their joint destination over different routes, a process that can help expedite communication by distributing the load among facilities. Route choices are made very quickly and dynamically by "routers," computing devices in the network loosely analogous to switches in conventional telecommunications systems.

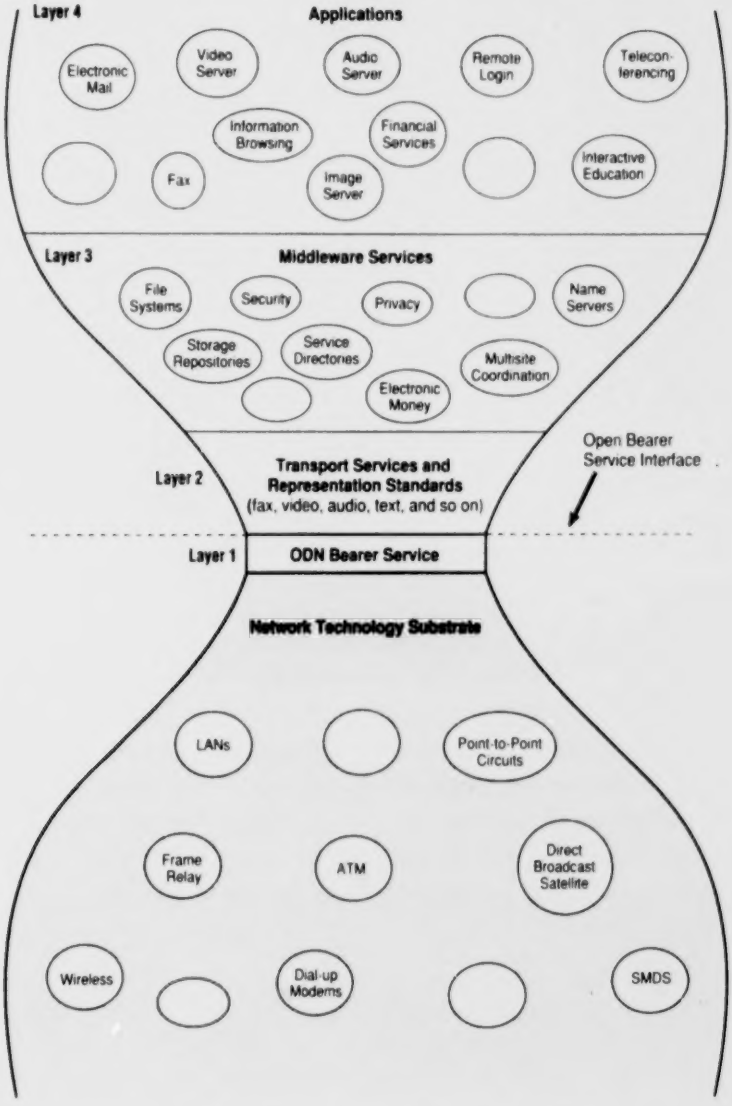
Because of its architecture, which has been implemented in open (nonproprietary) standards, the Internet epitomizes an "open network." Figure 1 presents the general model of an open network. What it labels the "Open Data Network Bearer Service" (the Internet Protocol in the Internet) is conceptually both the first layer when one focuses on Internet technology and the middle layer of the whole set of networking technologies involved.

The Internet uses a common set of communications and related services to deliver information transmitted from a wide and changing range of underlying communications technologies (devices and networks), via a wide and changing range of service providers, to a wide and changing range of applications. With these characteristics, the Internet is open to change: it can accommodate innovation in the underlying communications technologies without forcing changes in the applications, and vice versa. For these reasons, the Internet can be characterized as *general* and *flexible* technology, as can the computers of which it has been principally composed. Generality and flexibility differentiate the Internet from telephony and television. Telephone and television networks historically have involved network architectures tightly linked to those applications (with benefits in cost containment), thereby limiting the purposes to which such networks could be put.[13]

The Internet is technology and application independent because of the design of its essential software. Conceptually, the Internet's soft-

ware is a "protocol suite," that is, a layered structure of standardized protocols.[14] This protocol suite is the essence of the Internet architecture. The layers embody functions from connection to the physical means of communication to applications that represent tasks the user wants to accomplish via the Internet (e.g., send e-mail). This structure governs how the software system at a given layer relates to other soft-

Figure 1: Conceptual Model for an Open Data Network (the Internet)



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ware at adjacent layers on a given computer or other access device and how it relates to the software systems at the same layer on other computers with which communication is established.

The heart of the Internet protocol suite is the Internet Protocol (IP). IP defines functions that must be provided in the network, including a service model known as "best effort," which means that it doesn't guarantee that bits will be delivered in a specified time frame or even at all. IP also defines "addressing," a system for indicating where packets are intended to go and forwarding them until they get there. To date (i.e., through the current version, known as version 4 [IPv4]), the fewness of IP's functions has contributed to its ability to adapt to changes in both underlying technologies and applications. The future of the Internet depends in part on how the protocol suite, in particular IP, evolves.

The Internet architecture is said to assume that "intelligence" is at the "edges" of the network—in the devices and applications software that make use of its services (e.g., software for electronic mail or Web browsing)—and not in the systems that compose the body of the network (the routers), as is typical of telephony. Because of this edge-orientation and the internetworking described below, the Internet is characterized by decentralized control.[15] New goals for handling (transmitting, presenting, protecting) information give rise to additional encoding (at the application layer or an intermediate, "middleware" layer, which provides functions for the organization and management of information associated with networked services),[16] which is then encapsulated by the encoding associated with Internet transport.[17]

Internet applications that take the Internet in new directions are just that—applications—despite the tendency for special attention and new terminology to cluster around them. The World Wide Web is one such application. The Web adds another protocol, HyperText Transfer Protocol (HTTP), as an application on top of the Internet protocol suite.[18] The Web uses the Internet as a communications system (as the Internet itself uses telephony or another communications infrastructure), another instance of layering. Information can be located and shared through the Web because the information is formatted and stored appropriately for HTTP; actions associated with finding information take place via application software called "Web browsers" loaded onto the systems people use for access. HTTP is itself subject

to frequent adaptation (via new standards) to support different kinds of access (e.g., by people with certain disabilities, or by people using wireless/mobile systems) and different kinds of activity (e.g., mechanisms to enhance the commercial value of Web sites, such as security features to protect financial transactions and information-gathering features to collect data about site use). Support for "text-only" browsing facilitates use by people with low-bandwidth access by avoiding communication of bandwidth-intensive images.

The Web has affected the scale of the Internet, fostering the attachment of millions of new hosts and the proliferation of intermediate systems ("servers") that "cache" (copy and store) and distribute collections of Web-accessible information to moderate traffic load on the Internet. The Web has profoundly affected Internet traffic patterns, influencing both traffic distribution among locations and the size mix of communications. (Most Web interactions are small in size, in contrast to many files that scientific researchers transfer via the Internet.) The Web has added to the international flavor of the Internet by fostering international links to different pieces of information and stimulating the sharing and use of information across nations where language and literacy permit. (English is a common denominator, and is often an alternative on foreign-language sites, although in non-English-speaking countries it raises additional literacy concerns.) Thus the Web magnifies the impact of Internet architecture on global networking.

A second major Internet application is Internet telephony, which was developed in part to facilitate international calling by providing a cheaper alternative to standard long-distance service. Its growth, for inter- and intra-national calling, will affect the scale of the Internet. Internet telephony is already affecting industrial organization relating to telecommunications and associated policy by demonstrating the "convergence" potential enabled by Internet-style packet switching: telephony can be provided by Internet Service Providers (ISPs) that offer service over telephone, cable television, or native IP networks (with interconnection via gateways to the telephone network); traditional telephone companies are moving to deploy IP networks to further their support for both data and voice. All of this has taken place *within* the architecture of the Internet.

The Internet has physical substance (e.g., routers, host computers, network operations centers, wires and cables, and so on) that can be

described and associated with processes and functions (e.g., routing) that also can be described. But the specifics of what happens within a given facility at a given time (or to a given item transmitted) are hard to forecast. "Local" or national communications can be routed over disproportionately long distances; some of those communications may well traverse national borders even though sender and receiver are both in the same country. This international wrinkle has facilitated Internet use in many countries where communications and information facilities have been deficient and/or expensive, making Internet use and benefits possible through minimal local infrastructure.

The Internet: Net By Net

The above discussion of encoding and protocol layering presents a vertical picture of the Internet, focusing on what happens to information to be sent through or retrieved via the Internet. The Internet also has a horizontal dimension as an integrator of multiple networks in multiple places.[19] The Internet is, as its name suggests, an internetworking technology, a network of networks.[20] This dimension underlies the international reach of the Internet, which has long connected sites in multiple countries, primarily by interconnecting networks in different countries. This dimension also contributes to the Internet's characteristic decentralized control: no party is in charge of the internetworked complex as a whole, although identifiable parties are responsible for managing component networks (including "backbone" components that aggregate traffic from lesser networks), and although U.S. government funding for key Internet functions has associated the government with those functions in the eyes of many. The Internet's architecture enables interconnection; precisely what connections are made, and where, when, and how those connections are made, depends on economic/business and policy/government factors. It is the pattern of these actual connections that governs just how global and how open the Internet actually is.

In the United States and other countries, the Internet grew as a collection of aggregated national backbone links and smaller-scale networks aggregating and/or serving traffic in regions of various sizes from small campuses to major metropolitan areas. Commercial ISPs now range from local/retail companies to national/wholesale businesses, a distinction that is far from pure. The nature and mix of ISPs

serving a country or region are evolving with the marketplace.[21] ISP characteristics vary around the world, in part because of differences in telecommunications regulatory regimes. India, for example, just opened its market to ISP competition in the fall of 1998, while Australia's ISP population grew tenfold between November 1995 (63) and November 1998 (642).[22] In some nations, foreign investment is contributing to turn-of-the-century ISP growth.[23]

Interconnection does not imply service uniformity; nor does it make the Internet one network.[24] Negotiating interconnections (technically as well as administratively) has always been a part of the delivery of international telephony service; the broader objectives and greater variation in Internet service provision add further complications. Networks differ in various ways (e.g., speed of communications supported, reliability of service). The lowest quality network traversed may govern the overall experience for some communications and therefore what applications can be supported effectively over multiple networks. This variability has been a concern for the international community of high-energy physicists, for example, who depend increasingly in the Internet for communication and collaboration.[25] If the objective is to achieve any access, then the ability to do so with minimal infrastructure allows poorer areas to share to some degree in benefits available to those with richer infrastructures. In several developing nations, for example, access has often been limited to low-bandwidth telephone connections, which have been sufficient for applications that some have deemed "real-enough time,"[26] such as e-mail, and (with adaptations) have supported more sophisticated applications.

Indeed, some development experts argue against projecting broadband expectations prematurely on developing nations and argue for maximizing the use of less-demanding applications such as electronic mail.[27] The first steps themselves may be important for aiming in the right direction: Australia today is one of the world's leading Internet-using countries, but just five years ago it still depended significantly on manual telephone operators.[28] The transition from no access at all to 28.8 kilobits per second modems may be more significant than the current craze in developed nations, the transition from 28.8 kbps to megabits per second capability. The Internet is not all or nothing.

Better-endowed networks tend to be accessed by better-endowed users, which is one reason for data networking leadership by large businesses. The Internet embodies an exception to this economic cor-

relation in those segments that are government-supported research networks. Even before it was commercialized, the Internet linked private networks in universities, research institutes, and laboratories (including government and industrial laboratories) in different countries around the world. It originated as the backbone for the research network complex, saving money for individual research entities that shared in the use of this infrastructure and leveraging a modest amount of external funding.[29] Research interconnection reflects broader patterns of international collaboration in and funding for research, plus requirements for higher bandwidth than may be affordably available commercially.[30] Special efforts persist to foster traffic exchange among research and academic networks, regionally and internationally, offsetting the high costs of commercial networking by collective buying and some subsidy. For example, today, the STAR-TAP (Science, Technology, and Research Transit Access Point) exchange in Chicago serves an expressly international group of computational science researchers, with links to Canada, Russia, and Singapore as well as to U.S. networks.

The research networking experience provided an early model of network-based community building, based on shared professional interests, and it gave rise to informal community building over the same networks based on other, more personal, interests as well as to efforts to support civic communities via the network. In rural areas within developing countries, Australia, and Eastern Europe, community building is emerging around agriculture, beginning with exchange of market and production information. This use of the Internet complements the rise of precision agriculture, which involves greater use of information and information technology to manage farming. Resulting increases in yields motivate different and broader approaches to marketing agricultural output—and therefore demand for network services.

The rise of agricultural use of the Internet in rural and developing areas points to the potential for networked support of activities beyond the white-collar, service-industry applications that have dominated press reports and early discussions of electronic commerce. It illustrates the fallacy of assuming that the Internet is only valuable to urban intellectuals, big business, or other categories of early users.

The proliferation of component networks, both ISPs and networks associated with some enterprise (private or governmental), plus the corresponding proliferation of network users, points to growing investment at the edges of the Internet.[31] It also implies growth in the "installed base" of the Internet, especially through larger ISPs that have invested in their own networking facilities (as opposed to smaller ones, who resell capacity). At the same time, how and where traffic is exchanged among networks has become a topic on which new questions are being asked.[32] Research networks celebrate connectivity, but commercial providers and users are more discriminating, given their perceptions of costs and risks.

Because of its architecture, which was unleashed by commercialization, the Internet has been able to grow, net by net, to embody the vision of global networking. From a global perspective, what matters most in Internet use is the simple fact of having access. Although more of today's Internet and Web use takes place in urban than rural areas (given the superior local infrastructure in urban areas), the location of sought-after resources does not and will not necessarily correlate with typical population or business centers. Even the most modest level of access provides entrée to remotely located resources that can yield far greater benefit, at least in principle, than a long-distance phone call. For example, searching or retrieving information from diverse sources or contacting large numbers of people is more cost-effective via a session on the Internet than a series of phone calls. How easily—how conveniently and affordably—Internet access is achieved depends on the networks on which it is built.

III. FOUNDATIONS: BUILDING AN INTERNETWORK

The architecture of the Internet illuminates its many possibilities. But what people actually experience depends a lot on the nature of the communications technologies—the communications infrastructures—that undergird the Internet. Part of what makes the Internet exciting is that multiple forms of technology coexist and evolve within the larger architectural framework. This section highlights trends in wireline, wireless, and satellite technology now driving global networks, con-

cluding with a discussion of the experimentation that adds to the uncertainty about network deployment.

Regardless of physical location, the key concerns having to do with the Internet experience relate to communications capacity ("bandwidth") and access: how much, for whom, from where, and how symmetrical (support for two- vs. one-way traffic).[33] What actually gets deployed represents the interaction of available technologies and the economics of installation and use. Because, in principle, any commercially available technology can be used anywhere, international and intranational variation is driven largely by economics. "Local loops," the connections between a network and users' locations (e.g., from a residence to a telephone central office), are widely seen as costing about a thousand dollars each, a number that can easily double when full costs of projects are tallied in the developing world (e.g., costs of shipping, providing power for telecommunications, and assorted service elements). This figure is expected to fall to several hundred dollars relatively soon. Similarly, for a long time a fully configured personal computer was assumed to cost about two thousand dollars, a figure that has been halved recently and is expected to fall further. Moore's Law continues to drive rapid progress in computing, promising processors one hundred times as powerful as today's in a decade; increasing linkage of computers to network services promises new approaches to pricing strategy.[34] Changes in networking economics arising from changes in telecommunications regulation, increases in competition, and growth in networking demand are spurring deployment of several communications technologies that are shaping network growth and upgrading around the world. Today's communication technology mix will not be tomorrow's.

Neither linking to new or larger communications networks nor changing to new communications media (including the emerging fiber and wireless capacity) changes the *architecture* of the Internet. These changes do change the scale of use and perhaps the range of applications supported (including the ability to support audio and video over the Internet and the ability to support large numbers of users simultaneously). Both are relevant to the technology and management of the Internet. Although the late 1990s have seen substantial investment in capacity intended for Internet support (e.g., by MCI Worldcom and other ISPs), much capacity continues to be deployed to support con-

ventional communications—although it may also be used to support Internet traffic, too. A current debate in developing nations is whether to choose technology to deploy in remote and/or low-income areas with voice or with broader objectives; progress in technology, meanwhile, is blurring that distinction and changing perceptions of relative costs inasmuch as new ways emerge to get more use out of low-bandwidth connections and/or to supply higher bandwidth at lower cost.[35]

The close of the century brings considerable growth in both network backbone elements and the distributional tentacles that reach closer to individual users. There is also steady growth in number and capacity of international circuits and use of that capacity. Deployment of fiber-optic cable systems (primarily for network backbones) and wireless communications systems are the major trends. There are more variations on the wireless side, associated with competing standards and changing economic, regulatory, and technical elements, but the differences probably do not matter much for the long term.

Wireline Communications

Fiber-optic cable provides abundant bandwidth, making it popular for network backbones while it remains costly for reaching dispersed end users. Although the latter fact discourages "fiber to the curb" or household, the technology is getting closer to homes over time. Expectations for wave division multiplexing and all-optical networking may further spur deployment and use of fiber; technology advances extend effective fiber capacity. Fiber-optic support for international and in some cases intranational communications is also expanding. For example, trans-Atlantic cable capacity is growing substantially: about a ten-fold increase during the 1996–1999 period may, if deployment proceeds as planned, be followed by another ten-fold increase between mid-1999 and 2001. Trans-Pacific cabling is growing less dramatically, and a number of ambitious regional and even global (e.g., FLAG [Fiber-optic Link Around the Globe], Global Crossing, and, pending financing, Project Oxygen) undersea cable systems promise new capabilities for the Far East, Mid-East, Africa, and elsewhere.[36] Global Crossing and Project Oxygen, for example, each anticipate about one hundred landing points deployed in phases and distributed around the world. The submarine cable investment spurt

reflects a mix of factors: deregulation, the rise of private investment consortia (diversifying the supply side), growth in data communications demand, and technology improvements that increase capacity per cable. Lesser trans-border continental cabling growth, by contrast, seems to reflect less supportive regulatory and business environments, although this could change.

Wireless Communications

"Wireless" is a broad label that covers both terrestrial and satellite-based systems, as well as support for both stationary and mobile users; to oversimplify for explanatory purposes, bandwidth variation leads different systems to be associated with different uses. The proliferation of wireless systems is more visible than advances in cable, although wireless has proved less predictable in impact. Wireless systems must cope with several fundamental technical problems that are largely a function of difficulty in using air as the communications medium (signals tend to fade or encounter interference) and limits to assigned radio-frequency spectrum, which constrain how the airspace can be used and lead to different system designs in wireless systems.[37] Other issues arise in interconnecting systems to the main (wireline) telephone network (e.g., coordinating approaches to signaling to make sure that calls can be processed correctly) and, in remote/rural areas, in supplying power to ground stations. In developing countries, for example, solar and battery power have been introduced to keep wireless systems running in remote areas.

Preferences for different systems for different applications (voice, and low- and high-speed data) reflect associated costs—but anecdotal evidence makes clear that these preferences are mutable. That is, people are developing technology to get more data services out of low-speed systems, including those originally aimed at paging and cellular telephony. Some of the broader functionality may be asymmetrical: one can receive larger transmissions of data than one can send the same way.

Although wireless system development and use in general is framed by relevant standards, moves toward "software radios" illustrate how technology can be designed to adapt to whatever technology may be available in a given area. While today national investments

suggest a global battle for standards domination (notably, GSM [Global System for Mobile Communications] v. CDMA [Code Division Multiple Access]), it may be that access-device technology may overcome geographically defined incompatibilities. AT&T, for example, has already announced a multi-support cellular phone intended for international use.[38] In part because of the importance of standards and therefore international coordination for wireless communication around the world, wireless technology development has been encouraged by international programs that have related the technology to visions for economic and social development. Notable are the European Universal Mobile Telephone System (UMTS), presenting a pan-European vision, and the complementary International Mobile Telecommunications-2000 (IMT-2000) program of the International Telecommunication Union (ITU). Both programs express technology objectives in terms of visions of what people can do as enabled by international wireless networking.

The appeal of wireless reflects the economics of deployment (notably, low unit capital costs and more variable relative-to-fixed costs) for both rural and urban areas. Once a system is established, the operator spends on a customer only after a service arrangement has been made, and equipment can be recycled among customers. Terrestrial wireless systems can be fast and cheap to deploy, relative to fiber; satellite systems are inherently expensive, lumpy investments but comparatively cheap for serving large sparsely settled areas; and terrestrial wireless systems can be cheap enough to use that in areas where users have a choice some will opt for wireless service only. Thus, wireless communications flourishes today despite having received scant attention in the original discussions of information infrastructure of the early 1990s. Its prominence illustrates how perilous it can be to extrapolate from the technology mix of a given period.

Wireless capacity is growing in many developing nations (e.g., in Latin America and Asia), due both to cost and to sluggish deployment of wireline infrastructure.[39] Given the choices noted above about emphasizing voice or broader service in new deployments, wireless trends pose the question of whether broader telephony can be achieved as a service enabled by wireless Internet access, in contrast to the conventional expectation that telephony would be supported first. Affordability and consumer appeal have spurred mobile wireless system deployment (sys-

tems being introduced into remote areas tend to be stationary). Data applications are pursued for both low- and high-bandwidth systems, beginning with paging systems and basic e-mail and even browser support being added to digital cellular systems (including PCS or Personal Communications Systems). More substantial protocol support is under development to better leverage the Internet and the Web: MobileIP is a protocol being developed by the Internet Engineering Task Force; the proposed Wireless Access Protocol, which includes an adaptation of HTTP, is under development by a consortium.

Satellite Communications

Satellite systems are a special segment of wireless communications. Their role in the Internet has been limited historically, but increases in deployment and capability are directing new attention to satellite connections to the Internet. Based in outer space, satellites are inherently international. Because of their distance from ground-based users, they add to other over-the-air challenges such issues as signal delay (extra communications transit time) and interference from weather. Satellite-based systems are especially important in sparsely settled areas such as rural areas in developed countries and much of the land area of many developing countries), as well as for broadcast over large expanses (e.g., for television). Long used to support broadcast media and for some long-distance telephony, most satellites have used geosynchronous orbits (GEO). GEO satellites have supported (among other things) Very Small Aperture Terminal (VSAT) systems used in private networks and for access from remote areas, notably in developing countries. For example, cybercafes in India use VSAT links to ISPs, and VSAT-based telephony systems have been deployed in Thailand, South Africa, India, Egypt, and elsewhere. These systems may be linked to wireless local loop systems (e.g., those consistent with the Digital European Cellular Telephone standards) and ultimately to the wireline telephone network.[40] Relatively small devices, VSATs are easy to deploy but support low-bandwidth communication. They have been introduced in many countries (e.g., Egypt, India) to support corporate data networking, but newer installations (e.g., in Venezuela) support the introduction of public (pay) phone service in remote areas. New, more bandwidth-efficient approaches to GEO-VSAT technology are beginning to yield higher bandwidth, two-way

Internet support using low-cost radios for developing-nation applications.[41]

Recently, the direct broadcast satellite concept has been aimed at computer as well as television support, via such offerings as Hughes' DirecPC (and DirecTV), which overlay VSAT technology to enable reception of otherwise high-bandwidth Internet communication (but depend on phone lines for return communications). Similar approaches (e.g., via EUTELSAT) modify television receive-only antennas to provide higher bandwidth service.

The emerging deployment of large-scale, low- and medium-earth orbit (LEO and MEO) satellite systems will produce jumps in capacity for telephony and low-rate data communication (e.g., Iridium, which will support stationary and mobile users) as well as higher bandwidth service (e.g., Teledesic, which will support stationary users) aimed at Internet support. These systems combine intersatellite and satellite-terrestrial (e.g., Globalstar) infrastructure. They represent multi-billion-dollar investments, which implies an expectation of high volume and/or high-value uses; they have aimed from the outset to provide service in multiple countries but not necessarily in harder to reach, low-income areas, and they required international commitments to amass the spectral support required for their services. The satellite system investment will be recouped via service charges, but the customer equipment needs (the antenna dish and related equipment) and costs will be relatively small. The service charges are not necessarily fixed; Teledesic, for example, anticipates providing services that range from instant delivery to store-and-forward, at a corresponding range of prices.[42]

Improving Existing Capacity

In addition to the steps outlined above to introduce new capacity, steps are being taken (in the developed world in particular) to better use or upgrade existing telecommunications capacity. Although that phenomenon extends to broadcast television (e.g., the introduction of digital television and Web access via televisions), most attention tends to be paid to investments in telephony and cable television networks.

Where there is existing copper telephony infrastructure, there has been some resurgence of interest in Integrated Services Digital Network (ISDN) technology and in a newer family of digital subscriber line

(XDSL) technologies for purposes of Internet access. These technologies, especially XDSL, enable higher bandwidth communication (into the low megabit per second rates) over existing facilities with the use of special equipment by telephone companies and users. In the developing world, copper line quality is often too poor to even consider such upgrades, adding to the motivation for deploying new infrastructure. Networking of all kinds has been hampered in developing countries by fundamental reliability problems, which contribute to low-bandwidth, "noisy" lines and service interruptions in telephony and therefore in services that depend on the telephone network.

Higher bandwidth may be possible through cable television service, but this technology is deployed relatively unevenly around the globe, and where it is deployed (e.g., Japan), upgrading may not be rapid.[43] Cable television systems are replacing old coaxial cable technology and expanding into new areas using fiber, notably through combinations of coax and fiber that increase capacity. This upgrading is often tied to changes in system design and equipment to support Internet use, which—unlike delivery of television programming alone—requires capacity for two-way communication (communication from the home may be via phone, as in the early "interactive television" systems, or via the cable itself). The new cable television systems and modems presuppose that more bandwidth is needed to the home than from it (asymmetry), but at least in principle these systems permit some reengineering to support higher outbound capacity. Advances by local, multiple-system operators (MSOs) are complemented by advances by larger, nationally oriented providers (e.g., @Home and Time Warner's Roadrunner in the United States), which include building broadband Internet capacity and making capacity and service available to MSOs. International service arrangements are emerging, echoing expansion by larger ISPs. Although cable television industry activity seems somewhat constrained by regulatory uncertainty, pilot projects and developmental efforts illustrate that once cable begins to support IP, it is a small step to consider, as some cable companies are, telephony via IP over cable.

Infrastructure Experimentation

With the exception of the major fiber-optic cable and satellite deployments, the current environment favors experimentation via mar-

ket trials and relatively small-scale deployments. Experimentation is consistent with practice in computer-based markets, where time-to-market and competition have constrained pre-release assessment. Experimentation is even more prevalent in the application arena, where, for example, a variety of approaches to facilitating electronic purchases have not succeeded. In (wireline) telecommunications, where capital requirements for network deployment are high, caution can confine activity to experiments, at least in the short term.[44]

Not coincidentally, the technology alone has proved less predictable than some had expected. For example, a major approach to telephone and data networks, Asynchronous Transfer Mode (ATM), has not achieved the dominance predicted by telephone companies and other supporters. Their vision of a future networked environment typified by that of telephony has proven less flexible than the Internet. Similarly, ISDN and XDSL are seen as stop-gap technology.[45] ISDN and XDSL generate considerable public discussion only because they are credible near-term options; for the same reason, they may prove distractions. On a smaller scale, approaches to marketing the Internet and related services have evolved, as evident by the changing fate of America Online and Microsoft's attempts to develop service programs. That AOL has endured and even thrived, while Microsoft's approach floundered, cautions against rash assumptions when it comes to business models and their mapping onto technology.

Neither the Internet nor global networking generally evolve monolithically. As an internetwork, the Internet's value for global networking depends on the components that it integrates. Those components, in turn, benefit from favorable changes in technology, regulation, and costs, changes that have been explored by experimentation. Understanding component network trends is key to understanding observed Internet growth and preparing to deal with the broader set of ramifications of the Internet's evolution.

IV. EVOLVING TOMORROW'S INTERNET

The Internet has grown to be a common cause (and cause célèbre) for global networking. Its future as a common *architecture* for global networking depends on how it continues to grow. Part of the Internet's

appeal and resilience comes from the fact that it was designed to grow and to evolve; it is not obsolescent, and growth does characterize its near future.[46] But understanding its growth means going beyond the almost fantastic measurements that have become daily news fare. Exponential growth in the 1990s does not imply that the Internet will continue to grow indefinitely at such high rates.

This section outlines what it means to say that the Internet is growing. It relates the technical issues of scaling up to the associated institutional issues. Large scale in the Internet implies more people with a stake in how networks are deployed and managed. It changes the shape of industries involved in supplying network services and in deploying and owning pieces of the Internet. Large scale also raises questions about the resolution of cross-cutting concerns, which range from the technical to the social and legal. For example, complications in the setting of Internet standards are growing with the set of stakeholders.

Scale

From a technical perspective, Internet evolution hinges on accommodation of more and more users and possibly different kinds of support for different kinds of use. The Internet was designed for growth and for large-scale use, but the need to accommodate both continues to challenge the research community and industry.

Rapid recent growth prompts concern about how well the Internet can support addressing for an ever-growing population of connected devices, given the emergence of new needs associated with mobility of users, connectable devices, and a larger array of devices. Similar problems arise within telephony (as illustrated by periodic changes in telephone number format and assignment), and "convergence" begs the question of an integrated approach for both Internet and telephony. The process of planning and following up on the addressing problem, which hinges on nontechnical factors at least as much as technology, is revealing. It shows that it is possible, at least for some problems, to develop coping strategies (relatively modest albeit not indefinite adjustments, e.g., classless interdomain routing [CIDR] and network address translation [NAT]). It also shows that when it comes to more fundamental change, such as modifying IP and thereby the Internet's architecture, the broad deployment of today's technology (IPv4) has

generated inertia that slows the spread of newer and improved technology (such as IPv6), even where provision is made for backward compatibility. New software must still be deployed widely to implement the change. There may be few incentives to make that feasible in a given time frame.

Whether the continued growth of communications networks around the world results in ubiquitous access is a matter of definition. Contrasting economic conditions underscore the distinction between universal service—with the expectation of household or personal access—and universal access. The emergence of a near-universal interface, in the form of a Web browser, makes easier the resort to public access systems (e.g., kiosks, cybercafes) for the Internet where personal (portable or stationary) systems are not feasible. Such systems have been introduced in developed nations as an interim or compromise measure (e.g., library-based systems) or for controlled access to sensitive information (e.g., kiosks for Social Security information in the United States), along with subsidies for facilities in public-interest service-sites, such as schools, hospitals, and libraries.

In developing nations, public access systems are emerging as extensions to existing programs to deploy pay telephones to support villages or even groups of villages in such countries as India, Bangladesh, and the Philippines. Such programs range from single public/pay phones in remote areas to "telecenters" with multiple pieces of equipment and support for telephony, electronic and voice mail, fax, and Internet/Web access. They depend on the ability to extend communications infrastructure to these sites; Uganda, for example, had planned a telecenter to which it was unable to get a phone line.[47] The remote island of Tristan da Cunha acquired one terminal to support its three hundred people, but use is constrained by the expense of a satellite service cost of a few dollars per minute of use.[48] As long as national income is so low that the typical expectation of 1–2 percent GDP (gross domestic product) annual spending on communications cannot cover the costs of providing service to a household, it will be more realistic to expect communal, universal access than ubiquitous personal access.

Scale is expected to be compounded by growing heterogeneity of use: today's proliferation of users and access devices understates the potential for connecting more kinds of devices for more purposes (and users) to the Internet. Growth in Internet use will be measured not only

by numbers of people with access but, at least in some areas, by numbers of devices per person. Direct connection of household appliances and other mechanical devices, control systems for instruments and services, and embedded systems generally create networking possibilities way beyond those implied by (personal) computers or even telephones and televisions. Such unconventional connections raise new questions about facility networking (e.g., home networks), mobile networking, and more; they beg the question of whether or when an increase in quantity of network use may affect networking qualitatively—that is, may affect network architecture.

At present, support for sub-PC system connectivity is being pursued within the Internet standards-setting framework. The drive to support embedded systems promises growing capabilities for access via low-end systems. Although the "network computer" idea had a mixed reception in the United States, the concept of Internet use via systems with small displays, limited memory, and/or other compromises relative to full-fledged personal computers holds the promise of more affordable access systems for those unable to obtain PCs, both for public and personal access. The spread of wireless telephone handsets (and other hand-held devices) is a step down this path. The future will not be constrained by today's notion of what a computer is.

Quality of Service

Support for different kinds of use for the Internet generates a more complex response than support for scale, per se (recognizing that the two objectives may interact). The discussion above of the Internet architecture's openness to applications implies that support for multimedia communications is inherent in the Internet's design. That support is exploited most obviously by the Web, which has evolved from its original text orientation to support still and moving images and sound. Carrying such traffic is like carrying any other traffic, once encoded: what is transported over the Internet is "just bits" or "all bits."[49] Concern is growing about the volume of such traffic, especially where bandwidth is low, because it involves a lot of bits.

Internet telephony has heightened this concern, and it has also motivated changes in attitude toward telephony architecture to favor deployment of IP networks. (It is possible to layer telephony over IP as

well as IP over the telephony network.) The implications go beyond support for telephony, per se. Proof that, for example, sound (or video) can be transmitted effectively fosters development of multimedia support for collaboration, cultural exchange, games, and other activities.

The debate about whether to modify the Internet architecture to support the evolving application mix better falls under the rubric of "quality of service" (QOS). What QOS is needed for applications that have low tolerance for transmission delay and/or packet loss? To oversimplify the case, audio and video, or more generally applications with a fundamental real-time dimension, have less tolerance for transmission delay (and sometimes packet loss) than do electronic mail or typical large file transfer applications, both of which characterized the early Internet. The original Internet design for best-effort service implies that service guarantees are not offered, although it is possible to derive statistically an expectation of performance, so that, for example, under heavy use all users face slower service. The obvious illustration here is the "World Wide Wait." In practice, best effort serves as something of a floor on the Internet's performance, given the way the Internet has been provisioned and managed, at least in developed countries where reliability of the underlying communications infrastructure can be assumed. A principle of fairness (akin to equal opportunity) has so far guided treatment of packets, complementing the orientation to sharing. The alternative is to implement new mechanisms that will discriminate (in the sense of controlling admission to and therefore use of the network) among packet flows to provide service guarantees or predictive, lower-variance service. QOS decisions are not either-or; IP could support multiple qualities of service that could be invoked according to application needs.

Debates over whether and how to approach QOS reflect both Internet ideology and expectations about the evolving marketplace.[50] Proponents of QOS enhancements assume that without such modification the applications will not work well (consistently) or, by demanding more bandwidth, they will compromise other users by overcrowding network capacity (causing congestion, which can slow or even block communications) through longer and larger flows. Opponents argue the feasibility of proposed modifications (noting, for example, that they may not be supported in all networks traversed by a given instance of use) and suggest that the commitment to make sure that

network bandwidth (along with reliability) is adequate is easier and may be sufficient.[51] In the meantime, Internet telephony, music, and video applications are all growing.

At issue are development, deployment, and effectiveness of mechanism, as well as the balance between using a technical approach (mechanism) and pricing or other non-technical approaches to allocate capacity and service. Internet technology has not been conducive to (fine-grained) pricing mechanisms, for example, given lack of support for accounting. Discriminatory mechanisms raise questions about communicating needs for kind of service (in terms of delay or loss), delivery of the corresponding service, and predictability of service across an internetworked environment; provision for users to pay for a service that promises more than best effort; and scalability. (Some approaches may work at a small scale, e.g., an enterprise network, but not necessarily at a national or international scale.)

What is actually done and in what volume will depend on having viable business models: Internet telephony was launched to exploit cost differences arising from regulation of conventional telephony but not telephony over the Internet, but it is becoming a more general option. Multicast, by contrast, has yet to attract commercial ISP support despite growing use in research and public-sector contexts.[52] In general, novelty applications of the Internet are often harbingers of broader patterns of change in how networks are used. The proliferation of applications and service concepts evokes the prospect of bandwidth on demand, which could benefit both high- and low-income users and help to balance a variety of technical and economic concerns. Bandwidth on demand is a concept that epitomizes the business plan conundrum. It is also emblematic of international differences in networking prospects: uneven development of networks and network services militates against global QOS harmonization in the near term.

Management

The growth of the Internet in terms of numbers of users, numbers of component networks, numbers of service providers, and numbers of countries focuses attention on management issues at all levels. Complex routing and growing dependence on networking focus attention on the Internet as infrastructure, which implies functions from restoration of

service in the event of an interruption (which presupposes diagnostics and trouble-shooting capabilities and depends on qualities in the underlying communications infrastructure) to engineering the network to support likely levels of traffic and measuring and monitoring that traffic to guide other functions. These infrastructural needs apply as much to an enterprise network as to an ISP and/or national network. Networking experts argue that much more attention to control and management—and supporting technology—is needed in the Internet. By contrast, the centralized control-oriented telephone network grew up with control and management a more fundamental concern.

Additional motivation for control and management arises from the kinds of uses that may be made by authorized users—for example, uses that might motivate attempts to support QOS enhancements. Others arise from the potential for intrusions by unauthorized users.[53] Recognition of the range of behaviors that may be encountered among network users motivates policy to guide behavior; there are policies for network control, information privacy, information security, treatment of intra- and inter-network traffic, and so on.

The fact that networks can be distinguished as entities with administrative control (management) opens up possibilities for differences in policies and preferences among administrations; a person on network A may experience more restrictions than a person on network B, and the person on network B may find the network more dependable than the person on network A. Administrative control has impact at two levels: first, at the level of organizations that use networks and support actual or virtual private networks for their constituents, and second, at the level of organizations that sell network services. Actions based on some kind of institutional policy may be expressed in technical mechanisms relating to acceptance of traffic, routing, and network management that affect the matching of capacity to users, connectivity, and the kind of services different users have.

Concerns among network owners and managers about network dependability, protection of networked information assets, and so on, suggest a trend toward greater effort to constrain connectivity and routing. These private management actions, epitomized by the use of firewalls and packet filters generally in enterprise networks, and also by the current trend toward differentiating enterprise intranets and extranets for internal and external communications, bear on access to both net-

works and information resources.[54] The various protective efforts being explored yield mixed success, but they do build on the Internet architecture. The development of IPsec, the set of standards intended to increase Internet protocol security through encryption, illustrates some of the tensions: the incorporation of encryption secures the contents of what is communicated in the Internet, protecting the interests of senders and/or receivers, but obscures communication from network managers, including ISPs, who argue that they need to know something about the kind of traffic in order to engineer the network appropriately. At the national level, constraints are also expressed in efforts by governments, notably in developing countries, to control citizen access to network-accessible information deemed undesirable. People in the West have made glib remarks about the "Great Firewall of China," but the urge for control over Internet traffic may be as broad as it is difficult to effect.[55] The issue of ability to discriminate among bits cuts across many management and governance issues.

Governance

Public management issues and opportunities transcend individual networks, even in the absence of a single authority for the Internet. These issues will interact with private management issues to influence global networking. In the early days of Internet commercialization, some who had been involved in managing the research network components within the U.S. federal government commented on the sudden removal of "adult supervision."[56] Some supervision derives from managers of private/enterprise networks and large ISPs, but public attention to Internet supply and demand prompts discussion about more broad-based supervision and coordination. Broader attention to "governance" also reflects the recognition that Internet technology cannot be controlled manually in a meaningful way: the technology works in a highly automated way and extremely quickly, so that what matters is the assumptions underlying the design and what they imply for the ability to tailor network use (if not operation) to respond to nontechnical concerns.

Public network management issues are international because of the international nature of network traffic and network-based transactions. There are national stakes in the social and economic impacts of access to and use of the Internet. The question of whose assumptions

are embodied in technology is becoming as important as what those assumptions are. For example, IPsec has run into problems associated with U.S. controls on the export of encryption technology: developing the technology was only part of how to make progress. Encryption also illustrates government efforts to influence mechanism directly: U.S. government-initiated programs to foster government-accessible cryptographic keys have run into numerous objections, while conceptually related programs to be able to locate users of mobile communications systems have advanced under the aegis of public safety. The U.S. government has moved to reinforce its influence by negotiating with other governments to establish comparable and coordinated programs, and the spread of encryption will depend in part on the collective actions of various governments.[57] At the moment, public network management issues are quite confused because of the combination of national rivalries, changing industrial organization, and the proliferation of organizations and other parties seeking a say.

A group of Internet "founding fathers" concluded its paper on the history of the Internet by observing:

> The most pressing question for the future of the Internet is not how the technology will change, but how the process of change and evolution itself will be managed. . . . [T]he architecture of the Internet has always been driven by a core group of designers, but the form of that group has changed as the number of interested parties has grown. . . . If the Internet stumbles, it will . . . be because we cannot set a direction and march collectively into the future.[58]

Broadening participation in development of technical standards and multilateral policy calls into question the viability of the traditional Internet evolutionary approach based on "rough consensus and running code," an Internet Engineering Task Force motto.[59] The late-1990s assertions by the ITU that its responsibilities extend to the Internet are emblematic, reflecting growing recognition that information infrastructure is a common resource as well as a medium for activities with various implications. So, too, are the engagement in relevant issues by several other organizations in the United Nations family,[60] which together bridge interests in the developing and devel-

oped world, and the rise in attention by nongovernmental organizations generally. Although multiple institutions are contending for leadership or at least prominence in the governance debates, the ITU and other UN entities are distinguished by their ability to give voice to developing nation concerns.[61]

Public management discussions can be aggregated under the rubric of Internet governance.[62] Internet governance may come to influence the design of Internet mechanism and architecture by altering the environment for the delivery and use of Internet service and therefore the engineering "requirements." Current discussions of the domain name system (DNS), which affects the positioning of individuals and organizations in cyberspace through the ability to register for a domain name at all, as well as to register for the domain name of one's choice, revolve around management issues. Implications for economic competitiveness, on the assumption that the Internet is key to electronic commerce, have engaged officials in numerous governments (and nongovernmental organizations) in DNS-related debates.

Various aspects of Internet-based electronic commerce, from support for encryption to taxation, are lumped under governance. So, too, are some issues relating to the information communicated via the Internet. Concerns about privacy, protection of intellectual property rights, and restriction of access, especially by minors, to information deemed offensive are motivating technical experiments (e.g., the Platform for Internet Content Selection and the Platform for Privacy Preferences initiatives under the World Wide Web Consortium) involving labeling of information and using labels to control access (e.g., finding and filtering information) automatically. Actions in the developed world seem focused on restricting information flow on the basis of proprietary or parental concerns; actions in the developing world seem focused on enhancing information flow for the most part, given the relative dearth of information and the hope that more will promote economic development. Movement toward global networking highlights the areas in which national and regional preferences clash. Early governance issues provide an arena for testing alternative approaches and institutions for global resolution.

Industrial Organization

Internet governance issues are likely to be colored by evolution of the structure and competitive conduct of the industries associated with the delivery of Internet-related goods and services. As the ITU observed:

> The essential lesson to be learned from the Internet phenomenon is that competition is no longer a public policy tool which can be introduced in a completely controlled fashion and regulated within the confines of the traditional telecommunication sector. Competition in telecommunications is rapidly becoming a true market force whose evolution cannot be planned by policymakers, a force which increasingly is seen as best regulated on the basis of principles that are not specific to telecommunications, but derived from a broader economic, social, and cultural perspective.[63]

The backdrop of worldwide changes in telecommunications regulation is an obvious factor. It shows up as increases in the number of players in local, national, and international communications markets, and in the entry of private investors into the previously closed (governmental or government-backed monopoly) arenas for international cabling and satellite systems.

Among the results are the formation of new, smaller providers and the consolidation and growth of larger providers. Smaller providers, from telephone cooperatives to local ISPs, seem to persist in those areas least attractive to serve, such as rural areas in the United States and some developing countries, although developing countries also attract large players from other countries. A new kind of larger player is emerging to provide fiber-optic infrastructure aimed at Internet development, as illustrated by Level3 and Qwest.[64] Some trends underscore the role of scale economies in at least some communications infrastructure businesses, although the rise of non-facilities-based service providers highlight places where scale may be less important. That assessment is moderated by the observation of new kinds of vertical integration among facilities-based and non-facilities-based service providers, providers of different kinds of facilities (e.g., telephony and cable television), and providers of communications and content services. Relatively high levels of merger and acquisition activity is furthering this integration.

Paralleling vertical integration is the large-ISP practice of restricting interconnection, that is, what is referred to as "peering" arrangements.[65] Peers expect to exchange traffic symmetrically and therefore forego exchanging money to cover the costs of carrying traffic originating on the peer network. ISPs do differ (in geographic coverage, subscriber and traffic volume, and so on). Large networks have argued that comparatively small ISPs gain more benefit and impose more cost than large peers and therefore should pay for having their traffic collected and/or have fewer locations (or lower priority) for traffic transfer. Congestion at such public peering locations as the Network Access Points established when the Internet was commercialized has accelerated large ISP movement toward private peering, which is in part a tactic to avoid congestion. Significant movement toward restrictive, private peering would reinforce industry consolidation and exacerbate differences among component networks. It would motivate consumers to choose (where local access alternatives exist) larger ISPs, which promise broader and easier communication as well as higher service quality.[66] Further advantage to large ISPs could inhibit small ISP development and access in rural and other hard-to-serve areas in the United States. ISP diffusion in such areas is already inhibited by relatively high costs. What happens in any region and whether the long-run trend favors balkanization or harmonization will depend on the nature of interventions to promote service in hard-to-serve areas as well as the evolution of pricing and settlement schemes through private and public action.

Antitrust investigations of other kinds of Internet-related businesses, such as those of Microsoft and Intel at the fundamental systems level and MCI Worldcom at the ISP level, illustrate how government control may emerge through outlets other than regulation.[67] These antitrust investigations have international dimensions. Antitrust is proposed by some telecommunications policy experts (e.g., Peter Huber)[68] as a preferred alternative to regulation, because it is more compatible with market forces. Because communications and information markets are growing and changing relatively rapidly, it is unclear the extent to which market forces may prevail—and what that means.

However important business plans may be to the launch and growth of communications networks and services, what is a viable business plan with an Internet-based, global networking architecture is highly uncertain. Different communications services—cellular and

wireline telephony, cable and broadcast television, and Internet access—continue to rely on different business models, but movement of different industries into each others' businesses undercuts such distinctions. Artificial support, for example by developing-country government proscriptions of Internet telephony (e.g., in India and Bangladesh), is stop-gap at best. The Internet's architecture, because of its application and technology independence, is conducive to the unbundling of communications facilities and services. Unbundling of network facilities elements has been promoted, at least on paper, by changes in telecommunications regulation, but there is too little experience to judge economic viability.[69] Given the trends noted above, integration and scale may be the long-term expectations.

At the close of the century, Internet evolution seems driven by market forces. Investment is booming, and major players are emerging. The scale and the interconnection are great enough to focus attention on who is running the show and how. The Internet now needs more than a simple engineering consensus. Global networking certainly does, and any global resolution must acknowledge a spectrum that runs from management of an institution that uses networks to national governments and international institutions and policy. Scale and interconnection are also great enough to underscore enduring questions about who benefits from global networking and how: networking changes people's lives, and the consequences will feed back into networking technology and forward into a broad range of public policy.

V. LIVING WITH A GLOBAL NETWORKING ARCHITECTURE

Much of the discussion about global networks and international networking revolves around comparisons in access: can people communicate, and if so, how easily? If one has faith that rapid growth will yield broader access (to communications networks in general and to the information-rich Internet in particular) at a faster rate than historically, then it is time to think through the implications of achieving global network architecture and approaching a global networking experience.

Although a technical discussion of the Internet can focus on the pipes and plumbing, so to speak, any attempt to predict the future of the Internet and the implications of that future depends on understanding how and why it is and can be used. To draw from the opening quotation, a global network architecture would be grand and beautiful, but what would it do for the essential comforts of life? This section begins to build a framework for thinking about how networking and the supply and use of information interact and how that interaction, in turn, may motivate efforts to influence the evolution of the Internet. Feed-forward and feed-back relationships are multiplying as networking becomes more assimilated into society and links more segments of society across more places. Although it is an oversimplification, the goal here is to outline phenomena that are dynamic and ambiguous to illuminate factors driving global networking.

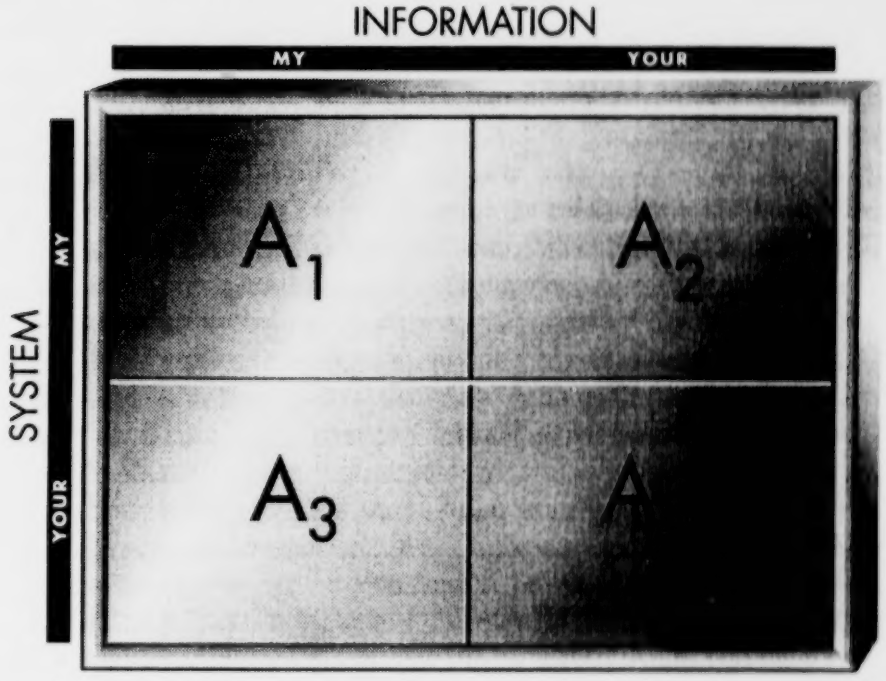
With the Internet shaping global network architecture, key issues revolve around the interplay of information and systems that some call cyberspace. The Internet allows people to own and access information on their own systems or on those of others, and it allows a given party's system to touch and act on information that belongs to that party or others. This kind of distribution in computing builds on the practice of having "client" systems that request information or other services from "server" systems. Increasingly, these processes of reaching out, requesting, and receiving may be automated—machines communicating with machines, software communicating with software.

Through the network (especially through a network that supports high communications speeds and low delay, allowing a sense of immediacy or real-time interaction), a process may look local but be remote; it may look monolithic but be distributed among multiple systems. A simple example of distribution is caching or storing material likely to be sought (e.g., the content of popular Web sites) closer to the user; another example is the collaboration of multiple computers in publicized challenge efforts to crack cryptographic keys. A party may call in or receive information from outside as well as ship it outside, and the same goes for software.

A given individual may have data handled by multiple machines and/or organizations; machines may handle data from multiple individuals and/or organizations; and pieces of software ("agents") may roam the Internet, performing tasks affecting data and systems. These

phenomena bear on what an individual does as an individual or as a member of a group that shares in some kind of communications or information exchange for work, play, or other purpose. Sharing of information or systems can be passive (post or fetch a Web page), it

Figure 2: Interplay of Information Systems and People



can be more or less time-sensitive (store-and-forward electronic mail can be received and read much later than when it was sent, while chat services involve immediate response to messages), and so on.

Consider the diagram in Figure 2, which abstracts relationships common to a variety of ways that people use information infrastructure. Cell A_1 (my information and my system) may be illustrated by conventional use of PCs without regard to networking; cell A_2 (your information, my system) may be illustrated by the fetching of a Web page—or perhaps my transmission of a Java applet or agent to work on your information; cell A_3 (my information, your system) may be illustrated by the sending of a Web page—or perhaps your transmission of a Java applet to me; and cell A_4 (your information, your system) may

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be illustrated by a set-top box or other means by which you control what I view and how.

This simple 2 x 2 representation is just the beginning of a set of possibilities. Realism can be added by dividing the ambiguous "systems" into application software and computing platform (this ambiguity was avoided by the use of "machine" above); my information, for example, can be processed by your software on my platform or yours.

Additional dimensionality is implied by expanding from a simple two-party world to one with multiple parties (my information, your software, her platform; my information plus his information, your software, her platform; and so on), comparison of multiple parties with shared objectives (e.g., conferencing, collaboration) and multiple parties with unknown or different objectives (e.g., chat rooms and multiuser domains [MUDs], electronic auctions), or processes that engage a given set of information on multiple systems or multiple sets of information on multiple systems. For example, in a modern enterprise with links to additional enterprises and other organizations and individuals, one can break up "information" to capture differences in sources, ownership, and/or access privileges (for example, I can access my information on my machine and your information on your machine for use with my software on a third party's machine; you are authorized to read information on my machine and to alter information via software on your machine and that of a third party). The multiple-party perspective capitalizes on the Internet's support for multiple styles of exchange: one to one (unicast), one to many (broadcast), many to one, and many to many.

Public access systems are a special context where the split between either information and systems or information, software, and platforms may be especially relevant. Public access systems beg questions about the costs and benefits of using personal, owned systems as compared to making do with what you find at the point of access. Public access systems also illustrate how interactions may involve different kinds of parties, including intermediaries (such as third-party system providers) beyond senders, receivers, and service providers.

The Web is celebrated as many-to-many communication, and that mode has many impacts. As more people in more places use interconnected networking and networked information, new questions arise

about the behavior of people sharing a common infrastructure. At issue are both intentions and actions, as expressed by how people handle information and/or systems. Such expressions as "communicate" and "share information" do not go far enough to describe what can happen in cyberspace, which can affect people directly or indirectly. The fact that people can, in effect, reach out through the network to touch remote systems or information repositories either directly or by initiating an automated process raises questions about what happens to either information or systems as a result. Experience with the Internet to date shows that open communication implies risks as well as benefits. Those risks relate to reliability and availability of network service, confidentiality and privacy of information communicated, and integrity of information and systems associated with a network or its use, all of which can affect lives and livelihoods.[70]

The involvement of communications networks underscores the physical separation of cause and effect that can complicate both diagnosis of and response to possible problems. Some risks are independent of where users may be located. Some are a function of who and where users are (e.g., nations that restrict access to pornography, nations that have hostile intentions toward other nations). Some risks result from bad system design or external forces (e.g., natural disasters), some from inadvertence, and some from malice. Risk motivates national security concerns and other national government concerns about the use of international networks.[71]

Location takes on a different kind of importance in the context of growing support for user mobility, via wireless communication. There are added challenges in protecting the confidentiality of information and of user location in over-the-air communication, for example.

In a world with so many users (scale and heterogeneity), one must assume less knowledge about those with whom one might exchange information or system access. Referring to the matrix, I may know who I am, but not who you are; I may know a diminishing percentage of the people with whom I communicate both knowingly and unknowingly. The potential to communicate and share information with almost anyone, individually or in groups, and the growth in pseudonymous and perhaps anonymous interactions, diminishes or eliminates traditional personal practice in assessing the trustworthiness of communicating parties. In multicast, for example, receivers initiate

communication by signaling that they want to join a multicast group, and participation may not be known to those initiating the group. In chat, MUD, and other interactive contexts, hiding identity may be both means and end. Other things equal, the expectations of both information and system owners may be unclear, unknown, or even incompatible.

Many risks associated with the Internet reflect how it and systems attached to it work. What happens within devices that connect to networks in order to effect communications (e.g., the encoding noted above), within a network to achieve communications, and in various places to manage the network (recognizing that management may happen "out of band"), is largely automated already. What happens within applications that use networks is also becoming increasingly automated. This process is epitomized by the movement of pieces of software across the network to perform activities sought by either end users or information providers. The practice of calling some software systems "agents" associates software with the intentions of people (principals), but how effective that link is may vary with the design of the software and the systems in which it operates. As experience with computer viruses and other "malicious code" shows, such software may not be benign. So many things can happen so quickly and invisibly that, absent some kind of built-in monitoring or controls and/or procedural constraints, exposure to a variety of risks may grow. The interconnection of multiple systems adds complexity that confounds understanding of how the compound, integrated system works.

Cyberspace today makes it hard to pinpoint the interconnections, the data, and the people with accountability. Some of these problems may be subject to technical fixes (e.g., the rise of metadata and other kinds of information labeling, identification and/or authentication of individuals and systems, and location tracking in mobile systems). Some of the uncertainty may abate if industrial consolidations shrink the set of system operators and managers, at least among ISPs; consolidation of information providers would pose other problems ranging from freedom of speech to the usefulness of available information. Some problems will yield to nontechnical adaptations that may make roles, rights, and responsibilities more explicit.[72] The movement toward global networking is prompting worldwide consideration of rights and responsibilities associated with network use, with broad

expectations for change in law and policy that will affect future interactions among people, networked systems, and information.

VI. CONCLUSION

The information infrastructure vision is fully global in scope.[73] So, too, is the set of players seeking to influence it. The crescendo of controversy and political conflict suggests a broadening potential for governmental and private-sector influence on the development and deployment of global networks at the same time that conventional telecommunications regulation is abating. Some of that influence must aim at international approaches that truly bridge differences in national outlook and resources—differences that are hard to overcome. Thanks to many positive contributions of the Internet, optimism is warranted. Yet questions will continue to outnumber answers in the near term; the stakes are too high to grab at the first answers offered.

Global networking will be facilitated by global architecture, and the Internet is today's obvious contender. Through its architecture, the Internet expresses a central plan and a consistency that transcend and integrate many kinds of networks in many kinds of places. Together with changes in regulation and other investment incentives, the Internet has motivated communications supply and demand. The ability to benefit from networking and the Internet seems highly uneven, like the ability to afford access, but a welter of technical and economic trends add up to potential for broader access and benefit. Despite the narrow scope of its early history and widening uncertainty about its institutional future, the Internet is the key to global networking.

The Internet has been a catalyst for network development and deployment around the world. Taken together, deployment activity points to changes in assumptions about what is scarce and what is plentiful—at least in the developed world, and to some extent in the developing. The conventional wisdom, which has shaped historic approaches to network evolution, has been that bandwidth is scarce. Internet technology development was motivated by scarcity in computing resources and affordable communications circuits; national differences in Internet use reflect differences in the costliness of bandwidth (circuit tariffs) among nations; wireless technology development has been

constrained by perceptions of scarcity of spectrum that are now being challenged; and expectation of demand for more bandwidth among users leads to discussion of local loops and last miles in terms of scarcity. Recent fears of scarcity of capacity in the Internet backbone—cast in terms of expected congestion realized as delayed or even blocked transmissions—were not realized, thanks to investment in fiber and other capacity and management of relevant facilities. Bandwidth scarcity, instead, is an issue at the local, access level. Because such scarcity will be alleviated first by shared access in hard-to-serve areas, especially in developing countries, "universality" must be seen as a flexible concept. Projects around the world show that people can make the most of the access they have. That evidence should impel efforts to improve access quantity and quality.

Where communications networks are accessible, discussion of scarcity has shifted to the information component: some now speak of *attention* as scarce, given the increase in information available over the Internet as well as through other media. The result is new technology for finding and filtering information to better match information communicated to needs, which in turn may yield more efficient (or effective) use of networks. Technology that may make better use of abundant information in more affluent areas may make better use of scarce communications capability in developing areas.

The Internet's architecture is a creature of software, and accordingly it imparts to global networking a malleability much greater than that of simple telephony. Although the Internet is associated with computer-to-computer communications, it enables a widening set of possibilities for what to do with a network. Exploration of applications and integration with voice-telephony and other popular systems suggest that the Internet's role in the future may depend on how well the computers can be hidden from the people who want to do something beyond "use a network."

What will happen when communication and information exchange take place without being sought explicitly? The embedding of computing and communications capabilities, associated with miniaturization and other technical trends, points to a future where networking is automatic and even invisible in the context of other processes that it supports. Although this future may be experienced first in more affluent nations, it can link people around the world from the outset. Does

it matter if no one, even oneself, knows who is connected to whom, where, and why? Many people are grappling with such questions, which are at the heart of national and international policy concerns.

Because implementing global networking requires investment, and because private parties drive investment, questions about public-private boundaries, rights, and responsibilities abound. If privately held infrastructure, for example, is deemed critical for some kind of defined public interest, who has authority over it? Global solutions must factor in private parties that are both local or multi-national in operation as well as a range of public "authorities."

An architecture for global networking raises many questions about balance of power among users, system administrators, service providers, and government entities—each of which may wear multiple hats and have multiple interests, and all of which may have to function with or want to share a common infrastructure despite some degree of mutual distrust. Over the past decade, the group of key decision-makers has not remained stable, nor is it even clear that decision-makers can be identified as they could before commercialization of the Internet. Looking at the varying players is like looking through a kaleidoscope: the arrangement changes, and more than one seems to work.

Key decisions about the development and deployment of global networks have been dominated by supply-side factors, from business models and competition to regulation and other government intervention. The Internet's history as a testbed for people to try out different activities as users and its extension to different kinds of people doing different kinds of things opens the door to broader influence from the demand side. Defining who is on the demand side is itself an issue; the history of data communications emphasized relatively large, institutional players (corporations, government organizations, research entities), while the Internet puts a bigger spotlight on individual users with the rise of home access and applications aimed at personal needs (health care, continuing education, recreation). Of course, realizing such individual benefits depends on having suitable access. Constraints on access and ability to use will not evaporate, even with sustained expansion of network deployment.

The benefits, risks, and costs associated with the interactions of information and systems will shape demand. We are only beginning to understand what people can and will do once they have access to net-

worked information infrastructure. That understanding shifts repeatedly as new technologies are tried and succeed or fail. For example, the emergence of progressively smaller and more powerful devices capable of network access, relaxation of regulations controlling cellular telephony services, and the numerous reasons why people want to communicate from wherever they are have impelled growth in mobile communications. This mix of technology, policy, supply, and demand will change the shape of global networking—a recurring process.

The current period of experimentation and growth emphasizes the benefits, but broader dependence and impact impels concern about risk. Viewed in global terms, the element of distrust is both shared and country-specific, colored by national security and economic competitiveness concerns. Those concerns are shaping national and international consideration of private and public controls on how networks are deployed and used and how information distributed and accessed via networks is handled. Individual nations such as the United States have begun to develop frameworks for protecting critical infrastructure from risks that transcend borders, thanks to international connections. More generally, growing dependence on networking motivates attempts to limit interconnection for various protective reasons.

Procedures and enforcement mechanisms being developed under the rubric of "electronic commerce" combine to make explicit some terms and conditions: what is being offered or sought, what is accepted, by whom (e.g., various kinds of disclosure, authentication), with what expectations (e.g., for price, delivery, and other primary elements of a contract or transaction; and for the handling of personal information). What is handled ex ante to prevent problems and what ex post to recover will evolve with experience and perceived options. It will also reflect national orientation to civil vs. common law, currently a factor in international negotiations. Of course, the fix for one kind of problem, such as accountability, may generate others, such as privacy.[74] What fixes will be accepted will depend on expectations and politics in the large.

How these issues sort out will influence how much information circulates primarily over the network—how people use communications networks.[75] It will also reflect the potential for and costs of uses not possible in other media. The current picture is shaped by the fact that warnings of dire consequences from using the Internet for, say,

electronic commerce without good (to the experts) mechanisms in place did not deter people from connecting and using whatever has been available. A global networking architecture emerged despite the persistence of local, national regulatory structures. People behaved as optimists, responding to the appeal of capabilities and applications, while public and private organizations scrambled to develop ideas about controlling network connections and uses. How will positive uses balance controls, and who will decide?

Assuming continued progress in deployment of communications networks, a central issue for the future of global networking is the continued development and deployment of open networks. Openness fosters international communication.[76] This quality is celebrated in discussions of Internet applications in international research collaboration, ventures in support of economic development and cultural exchange, and even development of a more global economy involving facilities and people around the world in a given enterprise or project. Even at large scale, those contexts are bounded in comparison to a truly global, networked information infrastructure or cyberspace accessible regardless of context of use—communications from anyone, anywhere, at any time.

However rapid may be the progress of the technologies that underlie networks, the progress of global networking will remain one of evolution. How networks identified with enterprises or geographic areas relate to the larger internetwork will define the openness of global networking and the impact of global networking architecture. The Internet demonstrates that architecture makes open, global networking possible in the absence of a single party in charge. The challenge for today's political economy, where many parties want to be in charge, is to fulfill that potential.

ENDNOTES

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for Information Studies' *Annual Review* Critique Session. The author remains responsible for the content of the paper.

1. See Heather E. Hudson, *Global Connections: International Telecommunications Infrastructure and Policy* (New York: Van Nostrand Reinhold, 1997), and "Development and the Globalization of Cyberspace," in *The Emerging Internet* (Queenstown, Md.: Institute for Information Studies, 1998), 129–148. Also see various statistical series published regularly by the International Telecommunication Union and the U.S. Federal Communications Commission (FCC), e.g., Jim Lande and Linda Blake, "Trends in the U.S. International Telecommunications Industry" (Industry Analysis Division, Common Carrier Bureau, FCC, June 1997; available online at *http://www.fcc.gov/ccb/stats*). See, also, Bella Mody's contribution to the present volume.

2. See, for example, World Information Technology and Services Alliance (WITSA), *Digital Planet: The Global Information Economy*, research conducted by International Data Corporation (Arlington, Va.: WITSA, 1998); available online at *http://www.witsa.org*.

3. This chapter does not detail the myriad forms of underlying communications technology because focused articles and books do so more effectively than space here would permit, and because the more important point for this chapter is that multiple forms of such technology coexist and evolve within the larger architectural framework. For representative articles and books, see Computer Science and Telecommunications Board, *The Evolution of Untethered Communications* (Washington, D.C.: National Academy Press, 1997); Computer Science and Telecommunications Board, *The Unpredictable Certainty: Information Infrastructure Through 2000* (Washington, D.C.: National Academy Press, 1996); and Terrence P. McGarty and Lee McKnight, "International IP Telephony," in *Internet Telephony*, ed. by Lee McKnight and David D. Clark (Cambridge: MIT Press, forthcoming).

4. Digital formatting for multiple media broadens the concept of networked information (sound, as well as still and moving images go well beyond the basic forms of text and numerical "data"), while fostering a common or integrated communication system.

5. For example, multimedia engages segments of the entertainment sector, artists, publishers, educators, and civil libertarians (among others).

6. Explicit development of governmental information infrastructure has been a goal in both developed (e.g., the United States) and developing (e.g., Korea) nations. Governmental infrastructure has been disproportionately important in developing nations, at least in Asia, reflecting the prominent role of government in such economies and more limited prior infrastructure. It remains to be seen whether communications infrastructure in those economies will remain relatively homogeneous and well-integrated as competition in communications emerges.

7. It is the fifth framework (1998–2002) for research, development, and demonstration.

8. This initiative grew out of discussions beginning in the mid-1990s and engaging a variety of NGOs. See *http://www.bellanet.org/partners/aisi/more/aisi.htm*.

9. Attention in international forums and nongovernmental organizations (e.g., G7/8; the United Nations [UN], and its affiliated International Telecommunication Union [ITU], World Trade Organization [WTO], and World Intellectual Property Organization [WIPO]; the Organization for Economic Cooperation and Development [OECD]; and the World Bank) underscores the collective interest in global infrastructure; new organizations, such as the Internet Society, have also focused on global networking. International forums bring out the tension between collaborative and competitive motives behind preferences expressed in developing terms and conditions for trans-border communication and information sharing. These tensions have been expressed historically in technical standards-setting processes and in international telecommunications decision-making, such as allocations of radio-frequency spectrum or telecommunications settlements accounting. They now emerge through these and other outlets, reflecting concerns about national stakes in the global economy enabled by networking.

10. In the United States, broadening access was a goal of the former National Research and Education Network program and is a goal of the coupled federal Next Generation Internet and private Internet2 programs; more generally and ambiguously, the goal of universal service was codified in the Telecommunications Reform Act of 1996.

11. Jasmina Kuzmanovic, "Wired-Nation Concept Fails to Connect with Singapore Residents," *Chicago Tribune*, 28 September 1998; available online at *http://Chicagotribune.com/textversion/article/0,1492,SAV-9809280063,00.html*. Small and densely populated, Singapore has been committed to linking its entire population to its new service, Singapore ONE. See Jason Dedrick and Kenneth L. Kraemer, *Asia's Computer Challenge: Threat or Opportunity for the United States and the World?* (New York: Oxford University Press, 1998).

12. This approach is typically contrasted to conventional telephony circuit-switching, which dedicates capacity to specific users for specific communications episodes or "calls." Telephony's circuit-switching is "connection-oriented," whereas the Internet is connection-less, each packet incorporating addressing information.

13. That characterization is changing now, thanks to the Internet and its promotion of competition among services.

14. Distinctions among layers do not imply that all functions are confined to single layers. Security, for example, may bear on multiple layers.

15. See J. H. Saltzer, D. P. Reed, and D. D. Clark, "End-to-End Arguments in System Design," *ACM Transactions on Computer Systems* 2, no. 4 (November 1984): 277–288.

16. Examples include finding and filtering information or electronic payment support.

17. Nested encoding illustrates the layering described above. This broad use of the term "encoding" is not intended to paper over important differences in the systems and techniques used to achieve differing ends.

18. Both the systems that store Web content ("servers") and those that seek it ("clients") must be configured to support Web activity (which presupposes that they are configured to support use of the Internet). As any user of the Web soon sees, the "information" that can be shared this way includes software as well as "passive" information; the software either helps to enliven a Web site or transmission (through, say, animation or music) or is offered as a product or service via a Web site. There are other ways to piggyback on Internet technology to enable software (so-called mobile code) to move autonomously from site to site in the Internet.

19. Note that traffic aggregation from small, local-area, and metropolitan-area networks into wide-area networks may be characterized as a vertical relationship, because of the hierarchical relationship among networks.

20. As Larry L. Peterson and Bruce S. Davie explain, "Every physical network that is part of the Internet has at least one router that, by definition, is also connected to at least one other physical network." See Peterson and Davie, *Computer Networks: A Systems Approach* (San Francisco: Morgan Kaufmann, 1996), 231.

21. For a late-1990s assessment that acknowledges change over time, see Shane Greenstein, "Universal Service in the Digital Age: The Commercialization and Geography of U.S. Internet Access" (Northwestern University, Kellogg Graduate School of Management, 21 January 1998 [unpublished]).

22. Oral remarks by Rosie Simpson (Director of Projects, Farmwide Party Ltd., Canberra, Australia) at the National Telephone Cooperative Association (NTCA)–World Bank First International Conference on Rural Telecommunications: "There Are No Boundaries," 29 November–2 December 1998 (NTCA, Washington, DC; *http://www.ntca.org*).

23. Pamela Druckerman, "Latin American Internet Market Gets Big Money," *The Wall Street Journal*, 12 October 1998, A15; Khanh T. L. Tran, "Thriving Japanese Internet Firms Hire Nontraditional Employees," *The Wall Street Journal*, 7 October 1998, A17.

24. Nevertheless, some homogeneity is promoted by the recent trend for private networks to use the Internet protocol suite internally, giving rise to the term, "intranet." This trend has provided private networks with greater flexibility for growth in scope and scale, following the lead of the larger "public" Internet. Some of that flexibility is associated with the construction of "virtual private net-

works," which use encoding and routing techniques (encapsulation and tunneling) with the Internet, following the pattern of virtual private networks (VPNs) that make use of the "public" telephone network to support private networking.

25. See David O. Williams, "Networking Needs and Prospects; the ICFA [International Committee for Future Accelerators] Networking Task Force Report," paper summarizing a plenary presentation made on Thursday, 1 September 1998, at the 1998 Conference on Computing in High-Energy and Nuclear Physics (CHEP'98), held in Chicago; available online at *http://nicewww.cern.ch/~davidw/public/CHEP98.doc*.

26. Gary L. Garriott, "Low Earth Orbiting Satellites and Internet-Based Messaging Services," proceedings of INET'96, 1996; available online at *http://www.isoc.org/isoc/whatis/conferences/inet/96/proceedings/gl/gl_1.htm*.

27. See Garriott, "Low Earth Orbiting Satellites"; and Peter Lovelock, "The Asian NII Experience" (1997); available online at *http://www.isoc.org/inet97/proceedings/E3/E3_2.htm*.

28. Oral remarks by Rosie Simpson.

29. Backbone funding by government was dwarfed by the local investment in computing and communications infrastructure for individual researchers, laboratories, and campuses. See Computer Science and Telecommunications Board, *Realizing the Information Future: The Internet and Beyond* (Washington, D.C.: National Academy Press, 1994).

30. For a discussion of the special flavor and concerns of research networks, drawing on high-energy physics, see Williams, "Networking Needs and Prospects"; and ICFA Networking Task Force, "Status Report" (July 1998), available online at *http://nicewww.cern.ch/~davidw/icfa/July98Report.html*.

31. These investments (computers and potentially other access or "terminal" devices; local area networks that concentrate access and distribution within a building; and campus networks that concentrate traffic among a cluster of buildings) have always been a major component of the cost of the Internet, a cost borne by users (organizations and individuals) as opposed to the "industry."

32. Prior to commercializing the Internet, for example, the United States had two federal government network exchange points, one each on the East and West coasts, which became the models for early commercial Internet exchange points. The change in status of NSFNET, a principal backbone, involved the establishment of "network access points" intended for traffic exchange. Growth in commercial ISPs has led, in turn, to provider efforts to control where and how much traffic is exchanged, as discussed in this chapter in the section titled "Industrial Organization."

33. In some locations, notably in developing countries, the quality of the service (ability to get and sustain a connection at a given bandwidth) is another issue.

34. See Elizabeth Corcoran, "Next: Personal Computers for Free?" Washington Business section of the *Washington Post*, 18 January 1999, 21–22.

35. "Universal service" programs may influence the choice. Detail on specific developments in specific countries and regions changes frequently enough to make e-mail discussion lists and current journal articles (such as the collection of articles on Asia in the November 1998 issue of *IEEE Communications*) among the better sources.

36. David O. Williams, "An Oversimplified Overview of Undersea Cable Systems," *Version 2.1*, September/October, 1998; available online at *http://nicewww.cern.ch/~davidw/public/SubCables.html*.

37. Propagation and interference problems contribute to relatively high error rates for wireless communications (giving rise to coping/compensating technology), in contrast to the very low error rates associated with fiber-optic systems.

38. See Brandon Mitchener, "EC Complains U.S. Spurns Rules For a Mobile-Phone Standard," *The Wall Street Journal*, 19 January 1999, A17; and "AT&T's Chief Expects Wireless World Phone Within Next Two Years," *Wall Street Journal*, 5 November 1998, B9.

39. In some cases, superiority to wireline infrastructure can be argued, as in this example presented by Larry Irving: "Take, for example, the town of Tochimilco near the Popocateptl volcano in Mexico. This village has only a few paved roads, but it already has 18 cellular phones and two satellite phones. . . . [I]f the volcano erupts, the few telephone poles and wires would probably be . . . destroyed. With mobile phones, however, the town would still be able to call for emergency service." See Larry Irving, "Wireless Opportunities in Latin America," remarks at the Personal Communications Showcase Latin America '98, 22 September 1998; available online at *http://www.ntia.doc.gov/ntiahome/speeches/pcs92298.htm*.

40. Digital local loop keeps local calls off of the VSAT system. In VSAT, different approaches (standards) to communications are being used. For example, single channel per carrier (SCPC) and combinations of both frequency- and time-division multiple access (F/TDMA) approaches are used in these systems.

41. One company that is getting a lot of attention for this kind of innovation is Tachyon in San Diego, California (*http://www.tachyon.net*). It promises speeds to the customer up to 45 megabits per second and from the customer of about 256 kilobits per second with continuous connectivity.

42. Oral remarks by Suzanne Hutchings (Teledesic) at the NTCA–World Bank First International Conference on Rural Telecommunications: "There Are No Boundaries," 29 November–2 December 1998 (NTCA, Washington, D.C.; *http://www.ntca.org*).

43. Bruce M. Hahne, "State of the Japanese Internet, 1997: Such Distance Traveled, So Far to Go," 20 February 1997, posted via Interesting People electronic mail list, available online at *http://www.interesting-people.org/*.

44. For a discussion of contrasting cultures among the computer and assorted telecommunications industries, see Computer Science and Telecommunications Board, *The Unpredictable Certainty*.

45. ISDN had been intended as a long-term solution, whereas XDSL had emerged more recently as a means to video delivery over telephone networks.

46. For a discussion about the orientation in the Internet development community to growth and change, see "Architectural Principles of the Internet," Internet Engineering Task Force Request for Comments number 1958 (Brian Carpenter, Editor, 1996; available online at *http://info.internet.isi.edu:80/in-notes/rfc/files/rfc1958.txt*.

47. Conversation with Rita M. Mukaaka (Uganda National Council for Science and Technology), 1 December 1998.

48. Michael Pollak, "Far Becomes Much Nearer As Web Touches an Island," *The New York Times*, 8 October 1998.

49. Bits are carried even though the original input and eventual output may be analog (e.g., sound). This perspective relates to questions that arise in business and public policy settings about whether the content of the bits, if it can be determined (in the first place), matters, and if so, to whom and why.

50. For an overview shaped by some skepticism, see Paul Ferguson and Geoff Huston, "Quality of Service on the Internet: Fact, Fiction, or Compromise?" (1998); available online at *http://www.telstra.net/gih/inet98/index.html*.

51. Increasing bandwidth may raise other issues; Michael O'Dell of Worldcom points to the difference between failing to fail and working. (Personal communication, 11 November 1998.) An intermediate approach (in the sense of not requiring new technology) is to split users or traffic into multiple networking services, charging more for higher priority service and using price-rationing to limit the volume and therefore delay on the higher-priced service. Andrew Odlyzko of AT&T is one analyst who has considered this option, and some of this kind of service differentiation is already evident in the marketplace.

52. Multicasting is an improvement (in terms of efficient use of the network) over the establishment of individual links from a sender to each receiver in a group. Individuals who wish to receive indicate their intentions; this is a bottom-up approach to group-building, in contrast to broadcasting. Multicast has been used for conferences and receipt of Internet "broadcast" programming.

53. For more on this topic, see John Fabry's contribution to the present volume.

54. Firewalls illustrate the broader tack of implementing intermediate systems, so-called "proxy servers." Instead of communication going through the network from sender to receiver, it goes from sender to proxy and from proxy to receiver; the proxy provides a gate-keeping function by filtering traffic and forwarding what is permissible.

55. Even the Chinese government has been able to control only partially the use of the Internet. "China generally ensures that its newspapers, magazines, radio, and television adhere to the upbeat, narrowly circumscribed script of the Communist Party. . . . China's dissident journals now are widely distributed over the Net." See Michael Moss, "In China, a Thousand News Stories Bloom on the Web," *The Wall Street Journal*, 18 January 1999, B1, B4.

56. Milo Medin, now with the company @Home, was fond of that expression based on his experience with the federal research networking community.

57. Broad deployment of IPsec, for example, is associated with establishment of an international public key infrastructure, which itself calls for international cooperation.

58. Barry M. Leiner et al., "A Brief History of the Internet," version dated 20 February 1998; available online at *http://www.isoc.org/internet/history/brief.html*.

59. See, for example, the restatement in the Internet Engineering Task Force Request for Comments number 1958: "Fortunately, nobody owns the Internet, there is no centralized control, and nobody can turn it off. Its evolution depends on rough consensus about technical proposals, and on running code. Engineering feedback from real implementations is more important than any architectural principles."

60. E.g., the World Trade Organization, the World Intellectual Property Organization, United Nations International Children's Emergency Fund, United Nations Development Program, United Nations Commission on International Trade Law, and so on.

61. Kenneth Neil Cukier, "Rich Man, Poor Man: The Geopolitics of Internet Policy Making," paper presented at the INET'98 Conference, 1998; available online at *http://www.isoc.org/inet98/proceedings/*.

62. Although governance is the term used most frequently, it has been argued that this usage promotes perhaps excessive government intervention. See Milton Mueller, "The 'Governance' Debacle: How the Ideal of Internetworking Got Buried by Politics," paper presented at the INET'98 Conference, 1998; available online at *http://www.isoc.org/inet98/proceedings*.

63. International Telecommunication Union, Draft Strategic Plan for the Union 1999–2003, dated 1998; available online at *http://www.itu.int/newsroom/press/PP98/Documents/StratPlan9903.html*.

64. Qwest has not only installed about nine hundred thousand miles of optical fiber in forty states and with international links, it is participating in the U.S. Internet2 program linking 130 universities, maintaining the historic Internet link to the research community. See Toni Mack, "Empty Pipes," *Forbes*, 30 November 1998, 76, 78, 80.

65. A sister issue is network operation and management practices by large ISPs that discourage multiple "homing" by customers, the connection to multiple ISPs to provide redundancy and other consumer benefits.

66. On the other hand, because it raises questions on issues from applicability of common-carrier status to ISPs to the potential for exercise of market power, peering has motivated public and government scrutiny, which itself holds in check some private conduct and may motivate government intervention. ISPs appear to be re-living or re-inspiring policy debates originating in conventional telecommunications. For a good overview of the motivations and consequences of peering trends and implications for regulatory decision-making, see Rob Frieden, "Without Public Peer: The Potential Regulatory and Universal Service Consequences of Internet Balkanization," *Virginia Journal of Law and Technology* 3, no. 8 (fall 1998): 1522–1687; available at *http://vjolt.student.virginia.edu/graphics/vol3/vol3art8.html*). For a discussion of recent controversies and to-date ineffective institutional responses, see Kenneth Neil Cukier, "Peering and Fearing: ISP Interconnection and Regulatory Issues," paper presented at the Impact of the Internet on Communications Policy conference (3–5 December 1997, Harvard University); papers available at *http://www.ksg.harvard.edu/iip/iicompol/first.html#Conference Papers*.

67. Growing government attention to the Internet is not limited to examination of regulatory prospects. The history of the Internet is one of government support,(notably in the United States) for applications of "public interest," including uses by researchers and educators. This kind of government involvement continues, and it may have further impact on the scale, technology, and possibly the architecture of the Internet. In the United States, a governmental Next Generation Initiative is intended to advance relevant technology via networking research and development. It is complemented by a private, university-centered Internet2 initiative. In Europe, the Trans-European Network is being upgraded (becoming TEN-155, for 155 megabits per second bandwidth) to support European research networks.

68. Peter Huber, *Law and Disorder in Cyberspace: Abolish the FCC and Let Common Law Rule the Telecosm* (New York: Oxford University Press, 1997).

69. For a discussion of the relationship between Internet architecture and the case for unbundling, other things being equal, see Computer Science and Telecommunications Board, *Realizing the Information Future*.

70. Computer Science and Telecommunications Board, *Trust in Cyberspace* (Washington, D.C.: National Academy Press, 1999).

71. In addition, the fact that a global information infrastructure intrinsically involves information transfer raises numerous questions about the qualities of that information (e.g., veracity, authenticity, legality) and their impact, although those qualities may be determined quite independently of the technology or how it is used.

72. Part of this process may involve roles and responsibilities for trusted third parties, such as certificate authorities, which are under discussion for public-key infrastructure and electronic commerce. See Computer Science and Telecommunications Board, *Cryptography's Role in Securing the Information Society* (Washington, D.C.: National Academy Press, 1996); and A. Michael Froomkin, "The Essential Role of Trusted Third Parties in Electronic Commerce," *Oregon Law Review* 75, no. 49, reproduced at *http://www.law.miami.edu/~froomkin/articles/trustedno.htm*.

73. An international process of discovery and discussion (that some date to the Clinton administration's 1993 announcement of the *National Information Infrastructure: Agenda for Action)* has featured assessment of how to advance information infrastructure within all nations, including among regions known for limited communications capability. Emblematic was the 1995 G7 Ministerial Conference on the Information Society, which framed collaborative demonstration projects featuring applications of broad public interest to principles of universal access, diversity, and assistance to economically disadvantaged nations.

74. Discussion about privacy impacts around the world is growing. See, for example, Global Internet Liberty Campaign, *Privacy and Human Rights: An International Survey of Privacy Laws and Practice* (1998); available online at *http://www.gilc.org/privacy/survey/*.

75. The choice among media will, as always, involve a balancing of multiple concerns, including processing, bandwidth, and storage costs, as well as perceived risks and policy constraints. See Bruce M. Owen, *The Internet Challenge to Television* (Cambridge: Harvard University Press, 1999).

76. The interdependence problem is compounded by interconnections among different kinds of infrastructure, notably the trend for transportation and power industries to increase their use of information infrastructure.

THE REGULATION OF GLOBAL NETWORKS: A EUROPEAN PERSPECTIVE

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I. INTRODUCTION

The growing emergence of global networks is giving rise to legal and regulatory problems on an unprecedented scale as it becomes clear that newly converging technologies, industries, and services fit rather badly into a tradition of country-specific, sector-specific, and technology-specific legal and regulatory frameworks. Matters are further complicated by large differences—even among industrialized countries—in the degree of development of global networks and in the share of total population having access to them.

This chapter discusses the need for some restructuring of the available regulatory frameworks. While this endeavor is urgent in the light of the massive positive externalities that could be obtained, any such restructuring should take fully into account the very large differences across countries in institutional frameworks, network diffusion, and utilization patterns. At first consideration, more centralized regulatory structures may seem to provide the best solution to this problem. But if we take fully into account inter-country differences, it can be argued that competition among legal and regulatory frameworks and bodies can provide viable, second-best solutions.

To support such a conclusion, Section II of this chapter lays out some major differences between the two sides of the Atlantic in network availability and usage. Section III discusses some implications of these differences for e-commerce; and Section IV evaluates the need and directions for a possible regulatory restructuring. Section V proposes some advantages of second-best solutions in the areas of privacy and Internet governance, a subject on which there has been considerable debate across the Atlantic. Section VI provides a round-up and summary of the chapter.

II. NOT-SO-UBIQUITOUS NETWORKS

The development of a Global Information Society (GIS) has been a key issue in European Union (EU) policy since the European Commission's 1993 "White Paper on Growth and Competitiveness," which laid out a broad vision of a fully integrated European economy, and its 1994 "Bangemann Report," which proposed a comprehensive approach to the building of an Information Society in Europe.[1] EU policy considers the GIS a new "industrial revolution" that can deeply influence ways of life and working conditions and can represent an enormous potential for job creation through the growth in demand of both traditional and new services.

In developing such a view, Europe has been working along the same lines pioneered by the United States at the outset of the Clinton administration under the general label of the "information superhighway." The European approach has, however, been different from that of the United States in one fundamental respect: in Europe, development of the necessary infrastructures has been considered chiefly the responsibility of the public sector, while in the United States the major driving force for network extension and upgrading has been liberalization, that is, the gradual removal of monopoly rights.

For years, Europe's long-standing public-sector approach was probably its only viable policy, because most telecom operators in Continental Europe were state-controlled well into the 1990s—indeed, Deutsche Telecom and France Telecom still are. The long-term impact of this public-sector approach has, however, been negative, as the digitalization of networks at the national level has proceeded at a slow pace

because incumbent operators have been wary of future regulatory obligations to provide cost-based access to their networks in a liberalizing telecom world.

The European Commission's 1993 white paper proposed an ambitious plan for investments in trans-European telecom networks totaling about 30 billion dollars by 1999. The plan was not implemented, as it was not considered economically viable given the tightening of public expenditure leading to the coming monetary union. Still, because total public investment by individual EU member countries was significant in the following years, it seems likely that the slow development of those networks was caused less by truly binding financial constraints than by the worries of incumbent operators. Even some less ambitious programs (e.g., TEN-34 [Trans-European Network at 34 Mbps]), based on voluntary agreements among individual countries, have been severely delayed by lengthy negotiations and have failed to deliver substantial cost savings once implemented.[2]

As a result, although seven private-sector backbone networks are currently under development in Europe, the bulk of interstate transmission capacity is still in the hands of national incumbents. Although it is difficult to acquire comparable data on backbone extension and capacity, Europe is at an obvious disadvantage vis-à-vis the United States, where—according to 1998 estimates quoted by the Organization for Economic Cooperation and Development (OECD)—over 40 major backbone networks are now in operation.

All this has had a substantial impact on prices in Europe; the OECD notes that it is currently cheaper to lease circuits across the Atlantic from Europe than it is to lease circuits for direct intra-European connections.[3] Data quoted by *Communications Week International* show that 2 Mbps national leased-line charges are up to four times higher in Europe than in the United States;[4] cross-national leased-line charges can be sixteen times higher.[5]

When compared to the United States, the "move to the Net" in Europe is thus, unsurprisingly, a very recent one. The earliest European links to the NSFNET backbone date only to the late '80s. Since then, however, the development of the Internet in Europe has been impressive, with the number of hosts doubling nearly every year. There is, however, still a large gap between Europe and the United States. According to estimates by Network Wizards, the number of hosts in

Europe by July 1998 was 5.4 million, or about 15 percent of the world total. At the same time, the United States had about 58 percent of the world's hosts.[6]

When Internet access is measured by the percentage of households connected, such differences appear even stronger. According to figures from the U.S. Federal Communications Commission (FCC), 23 percent of households in the United States were connected to the Internet in 1998, with an access market worth about $6 billion.[7] In contrast, according to rough estimates by the European Information Technology Observatory (EITO), only 3.4 percent of Western European houses had a connection to the Internet at the end of 1997. Although comparable data on business connections to the Internet are not available, indirect evidence for Europe, again supplied by EITO, shows that the share of PCs connected to the Internet (both households and businesses) was 11 percent in France and Italy, 20 percent in Germany, and 21 percent in the United Kingdom.[8]

Lower penetration of Internet access in Europe reflects in part a lower overall diffusion of PCs, especially in the household segment, but available data from the OECD show a significantly negative correlation with both total cost for final users (i.e., Internet Service Provider [ISP] fees plus telecommunication costs) and 2 Mbps leased-line charges (which give a good indication of the costs ISPs face in order to provide high-speed access to the backbones). In contrast, U.S. final users have benefited from the early liberalization of long-distance telecommunications, which has brought down costs to ISPs.

It was also quite lucky for development of the U.S. Internet market that a flat-tariff local telecommunication pricing structure was already in place, a pricing structure that turned out to be wonderfully suited for promoting rapid Internet penetration. Such a local flat tariff probably provides a reasonable proxy to the cost structure of digital technologies now being installed in the local loop. Its historical origin, however, has nothing to do with technology, but rather with regulators more concerned with the pursuit of voters' happiness than with subsidy-free, cost-based pricing. Nonetheless, it provides an enormous incentive to rapid diffusion of the Internet.

European local rates were (and are), in contrast, time-based. This pricing structure may be technologically reasonable, but it clearly

depresses demand for time-consuming telecom applications such as Internet access.

In conclusion, significant differences exist on the two sides of the Atlantic in the availability of networks and in the cost of access to be borne by users. As a result of these differences, networks are not quite ubiquitous, and only potentially global, even if we restrict attention to the industrialized countries. Among those, according to an estimate, Europe is lagging two to three years behind the United States in terms of Internet exploitation.[9]

III. THE ACCELERATING PROGRESS TOWARDS E-COMMERCE

Although reliable data are difficult to obtain, there is little doubt that Europe is lagging significantly behind the United States in e-commerce development, both in terms of turnover and of the growth of innovative, specialized "cyberfirms." The European Commission is indeed very worried about this.[10]

The essential requirements for the growth of electronic commerce, as laid out by the OECD, are:

- enhancing the information infrastructure for electronic commerce;
- building trust for users and consumers;
- establishing ground rules for the digital marketplace; and
- maximizing the benefit of electronic commerce.[11]

This section discusses the progress being made by the European Union in these four areas.

Enhancing the Information Infrastructure

In the last two years, Europe has been quickening its pace of liberalization, a process that is gradually enhancing its Information Infrastructure. The turning point of EU policy has been the total liberalization, from 1 January 1998, of the construction and use of "alterna-

tive" telecommunications infrastructure (i.e., alternative to those owned by the incumbent telecom operators).[12]

Under EU law, as discussed below, National Regulatory Authorities (NRAs) have very wide powers in determining the actual pace of implementation of the directives in EU member countries. This has resulted in uneven national development, with a faster growth of alternative infrastructures in the Nordic countries, Britain, and Germany, and a slower pace elsewhere.[13] However, by mid-1998 there were, in total, 195 operators licensed to offer voice telephony services over fixed lines in Europe. While not all of them were actually operating, due to a host of national regulatory obstacles, this number clearly points towards a coming rapid enhancement of the European Information Infrastructure.

Building Trust

Building trust does not, at the moment, seem to be a major issue in Europe, and certainly not a limiting factor of e-commerce growth. Indeed, the United States is currently more interested in issues of trust-building than is Europe. This situation probably reflects the limited diffusion of European e-commerce both in the business-to-business market (firms use it only with partners they already know and trust) and in the household market (fewer PCs and fewer credit cards in Europe make e-commerce the domain of high-income, sophisticated users).

This state of affairs may quickly change, though, as European households discover the advantages (and the risks) of financial dealings over the Internet. There is clearly a high potential for Internet financial services in Europe, as differences in banking and brokerage fees across countries are extremely high. Further, exchange-rate risks that once prevented European households from shopping across borders for the best deals have been eliminated since January 1999 by the introduction of the Euro.

As the various national financial markets provide different degrees of transparency and consumer protection, trust building for e-commerce in this area may indeed become a more relevant issue in Europe in the future. It is not, however, a particularly relevant factor at this time.

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Establishing Ground Rules

The drive to establish ground rules for the digital marketplace is an area of parallel concern on both sides of the Atlantic: taxation, data protection, security and authentication, liability, intellectual property rights, and illegal and harmful content are the major items on the trans-Atlantic agenda. Indeed, in most areas, policy on the two sides of the Atlantic seems to be developing along similar lines. A major exception is, of course, the issue of data protection, which will be discussed later in this chapter.

Apart from this, the construction of ground rules for e-commerce seems to be chugging along at similar speed in the United States and in Europe, and does not seem to be a limiting factor towards the expansion of e-commerce in the latter area.

Maximizing Benefits

Potential benefits to users could be more difficult to obtain in Europe than in the United States, for both cultural and structural reasons.

On the cultural side, it is quite easy from an American perspective to underrate the importance of a taken-for-granted common language and culture in the rapid building of a critical mass of popular applications. Europe has no single common language or culture; indeed, not many European households are ready to communicate in English, and thus to exploit the full benefits of the Internet.

Several structural issues also limit potential benefit. First, as mentioned above, consumers are not accustomed to cross-border shopping in Europe, as this historically meant bearing exchange rate risks and high transaction costs. While both negative factors are disappearing with the Euro (even though banking charges on currency exchanges and fund transfers are still high), their influence on consumer habits will fade only with time.

The business sector provides a second major negative structural factor: the very large presence of small firms. Small firms typically face technological problems with Internet access, language difficulties, and historical exchange rate risk-aversion that are not very different from those experienced by households. As these firms typically account for a very large share of manufacturing and service output (especially in the Southern European countries), demand for e-commerce services from

the business segment in Europe tends to be more limited than that in the United States.

Among other structural factors that explain the slower diffusion of e-commerce in Europe are the slow diffusion of the physical infrastructures for e-commerce, and the high costs that users have to face to access the Internet.

Europe is making significant strides in development of the essential requirements for the growth of electronic commerce outlined above. What is needed to accelerate this growth is regulatory restructuring, the subject of the next section of this chapter.

IV. THE NEED FOR REGULATORY RESTRUCTURING

At a very basic institutional level, both the United States and Europe share problems that arise from the coexistence of two regulatory layers: state/national and federal/supranational.

If regulation in telecoms had to be designed from scratch, a centralized system might seem optimal, because:

- global networks inherently require centralized regulation on most technical (standards) and economic (interconnection) issues, due to broad coordination and spillover effects, while:
- heterogeneous local rules systematically tilt the playing field in favor of the incumbent (be it a U.S. Local Exchange Carrier [LEC] or the national operator of a European country).[14]

In such a centralized regulatory scheme, some functions should obviously be left to local regulatory structures, particularly in the areas where specific conditions are very important (e.g., the precise definition of universal service).

In reality, however, a "dual regulatory system," as Bill Lehr and Thomas Kiessling aptly name it, exists both in the United States and in Europe, although for different historical reasons.[15] In both systems, the local level has much broader functions than would seem appropriate.

In Europe, this problem is often seen as the direct consequence of the so-called *subsidiarity principle*. Article 3B of the 1992 Maastricht

European Treaty sets out that "the Community shall take action, in accordance with the principle of subsidiarity, only if and in so far as the objectives of the proposed actions cannot be sufficiently achieved by the member states and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community."[16]

As Jacques Pelkmans notes, a straightforward economic interpretation of Article 3B is that it states two necessary conditions for EU action in areas that do not fall in its exclusive competencies stated elsewhere in the Treaty:

- the existence of scale effects in some areas, where individual action by a member state would be inadequate, in that it would entail excessive costs or provide reduced benefits;
- the existence of relevant effects that go beyond the frontier of that particular country and affect other member countries or the Union as a whole.[17]

Little doubt exists that both conditions occur in the building of the "common information area" that will provide the core of an Information Society in Europe;[18] action by a single member state in various areas (e.g., intellectual property rights [IPR] or telecommunications) could actually entail negative cross-border effects that introduce delays in the interconnection of networks or in the free flow of services and content.

No action, however, has been taken by the Union to this effect. To the contrary, while European-level legislation has proceeded in subsequent steps towards liberalization, substantial room has been left, in the name of the subsidiarity principle, to member states concerning when, how, and with what adjustments to implement European directives at the national level. As we saw above, this practice has resulted, throughout the early 1990s, in a slow liberalization process both within each country and across Europe, a process that has only recently seen an acceleration.

Nor has any Union action been undertaken towards the construction of a European-level regulatory authority, and rather bland substitutes (such as regular meetings of representatives of national regulatory authorities) have had little impact.

Although both Europe and the United States carry relevant costs from the existence of inefficient dual regulatory systems, the European case seems to be more serious.[19] In the United States, for example, long-distance telecommunications carriers have been increasingly liberalized since 1984, while in Europe the 1998 liberalization deadline has so far had influence—slowly—only at the national level. Further, in the United States, the concept of service-based competition is well-established and has been taken forward by the 1996 Telecommunications Act, which requires LECs to provide local-loop unbundled elements.

This situation gives a new entrant a broad array of entry strategies, ranging from the pure reselling of capacity to the lease of specific network elements (e.g., the twisted copper line into the customer's premises) to a full interconnection agreement based on the use of all the switching and transmission facilities of the incumbent.

Europe, on the whole, seems still to embrace the concept of facilities-based competition. Indeed, EU directives are ambiguous on the subject of local loop unbundling. Where such provisions have been applied, as in Germany, charges so far have been quite unfavorable to new entrants.

Furthermore, the broad shift of regulatory powers towards the center that seems to an European observer one of the key features of the 1996 Telecommunications Act, seems—after complex litigation—to be proceeding in the United States. No such trend is, so far, discernible in Europe.

Regulatory restructuring is thus a priority in Europe, even more so than in the United States. It is, however, on the whole unlikely that the broad political agreement necessary to increase the level of centralization will be reached by several countries having very different competitive positions in telecommunications. And although an alternative to centralization could, in theory, be provided by increased coordination of the NRAs, differing national interests would be likely to weaken the practical impact of this solution.

An entirely different solution could come from an increasing competition among local regulators. Weighing their affection towards the incumbent against the chance of attracting investment and creating jobs in the restructuring of the European economy following the

monetary unification, local regulators could be tempted to take the lead in liberalization.

There is indeed a growing evidence of this solution beginning to happen. Within the past eighteen months, some aggressive rulings on interconnection prices have been enacted in France, Germany, and Italy by national regulators. Britain and the Scandinavian countries have taken some rather strong liberalization steps in mobile telephony, by requiring the major established operators to provide cost-based interconnection to fixed-network operators and extending to mobiles number portability. Such a process should by no means be taken for granted, as reversals are possible, especially in countries such as Germany and France, where the incumbent operator is still state owned. Further, it is unclear whether deregulation process driven by competition among regulators could indeed reach sufficiently coherent results.

This remains, however, a noticeable trend, and could speed significantly telecom liberalization in Europe.

V. COMPETITION AMONG LEGAL AND REGULATORY FRAMEWORKS

Adapting nations' legal and regulatory frameworks to the emergence of global networks is a daunting task in which institutional problems mingle with national interests. The problems to be solved are indeed very many, and the potential for litigation correspondingly high.

As discussed above, centralized solutions could provide a first-best answer to several issues likely to arise. In light of the extent of national differences that were outlined at the beginning of this paper, however, the scope for a centralized approach seems in practice to be quite limited.

Shall we start looking for second-best solutions?

The answer is yes, and actually—from the point of view of fostering the growth of global networks—second-best solutions are rather attractive, in so far as they promote fast market growth, and hence provide the opportunity of reaping positive network externalities of increasing magnitude. Second-best solutions are obviously countless. Here I would like to draw upon the discussion of the previous section, stressing the case for competition among legal and regulatory frameworks.

Let us take privacy as an example.

The European Union has adopted a directive on privacy that grants a number of rights to individuals concerning data about themselves.[20] These include the right of access to the data, the right to rectify incorrect data, the right to possess information about where the data originated, the right to know the purpose of the data collection, and the right to opt out of allowing the data to be used in certain cases; it also requires an explicit consent for the processing of sensitive data. In addition, this directive limits the transmission of data to countries not having an equivalent level of privacy protection (notably the United States). This means that data should be transferred to a non-EU country only if they will be adequately protected there, although a system of exemptions applies for data where the subject has given consent, and which is necessary for performance of a contract, to defend legal claims, or to protect vital interests. The adequacy of safeguards concerning data transfers to non-EU countries will not necessarily require those countries to apply a similar legislation; alternative systems, such as voluntary arrangements or binding contractual clauses may be considered adequate.

This matter is obviously very relevant for the creation of a global network, as privacy issues are widely perceived as relevant by Internet users. According to research quoted by the OECD, 70 percent of consumers fear that the privacy of their personal data is more at risk with the Internet than with the telephone or postal services.[21] This fear prompts 41 percent of respondents to the survey to exit a Web site when they see a registration request, and 27 percent to say that they supply false information.

Historically, countries differ in their approaches to privacy issues. Broadly, European countries have a tradition of legal protection while the United States relies on a mixture of federal legislation (such as on video and cable subscriber records), state legislation (for biometric databases), and industry self-regulation. Understandably, the United States has reacted strongly to the EU directive, which may put American companies at a substantial disadvantage.

There are obviously different evaluations of national track records in privacy protection,[22] but the question we should really ask—in the light of the current EU/U.S. controversy—is what kind of approach is best within the framework of the developing of global networks that will carry an exploding number of transactions.

If the world consisted only of America and Europe, it seems likely that some kind of self-regulation could be made to work, but it is hard

to believe that, say, Ruritania would not see a typical free-rider incentive to break individual privacy and engage in trading consumer records. This would obviously open a florid "data laundering" industry. While this risk is not eliminated by legal protection alone, such a framework looks far more promising than a self-regulatory one. Still, the point here is not to discuss which solution could be the best, but rather to ask whether this could be a case where competition among legal systems may bring about some benefits.

I am inclined to think it would, as EU countries will in practice be rather cautious about applying the directive, taking a case-by-case approach. I would also expect U.S. companies to adopt higher standards of privacy protection in order to comply with EU legal requirements. This is obviously far from being a first-best solution, but it might actually help increase the general level of privacy protection without much damage to the international activities of firms.

Let us now take another example, that is, the matter of jurisdiction over the Internet. At the time of the writing of this chapter, several of the trans-Atlantic squabbles on Internet governance (such as the handling of the domain name system) seem to be in the process of being solved. This may not yet be true with jurisdiction. The EU, here, is worried that the United States may try to consolidate a permanent jurisdiction over the Internet as a whole, including dispute resolution and trademark protection.

The matter of jurisdiction, to an economist, is a problem of efficiency. One is tempted here to joke about who on earth would wish to import the American system of litigation, but there are more constructive approaches. Again, competition among legal systems seems of interest. This principle has been usefully applied during the construction of the European single market in the shape of mutual recognition and country-of-origin regulation. If a French bank wishes to operate in Germany, for example, it no longer needs any form of authorization by German authorities, and its activities there are regulated by the Banque de France. Obviously, country-of-origin regulation requires a high degree of similarity among national legal and regulatory frameworks to ensure a reasonable level of consumer protection.

Could such a system be applied to dispute resolution on the Internet? Not in its straight form, as again we would face extensive free-rider problems: Ruritania would offer a convenient location from which

it could be easy to cheat the world's consumers, who would be deprived of any protection under Ruritania's legal system.

It would, however, be interesting to analyze further if a country-of-destination framework could be adopted. This would surely be unwelcome to sellers, as they would face very different legal risks across different markets, but such a framework would encourage convergence in legal systems: if Ruritania had a system of obscure and baroque regulations, nobody would sell anything over the Internet to its consumers, who would soon be clamoring for a change in Ruritania's laws and regulations. Here, again, competition among legal systems may turn out to be beneficial.

VI. CONCLUSION

Networks are often held to be characterized by sensitivity to network externalities, that is, for example, the welfare of any person connected to the network is increased by any newcomer, as this increases the potential for communication.

From this point of view, global networks have a very high potential for welfare enhancement on a global scale. The scope for such enhancements grows larger with broader ranges of services offered on the networks and activities in which users may engage. The potential for enhancement is thus enormous for broadband, fixed or mobile, ubiquitous networks that people and firms may use for communicating, doing business, and being entertained.

The policy consequence of all this is simple, but rather far-reaching: it is better to adopt second-best policies that make the network grow faster than to waste time trying to implement first-best solutions.

Anyone familiar with the debate of the early 1990s about how unresolved IPR (intellectual property rights) issues would slow down the development of networks and services can see that IPR issues are still largely unsettled, but networks have grown enormously. Nor does there seem to be any shortage of content.

A clear and consistent legal and regulatory framework for the global network could well then be the receding pot of gold at the end of the rainbow (or network). Policy should, therefore, emphasize speed, an

emphasis that will not generate a coherent framework, but will rather foster competition among different legal and regulatory frameworks.

This will bring some waste of effort and resources, but will deliver a faster growth of global networks, and possibly also increase their ubiquity.

ENDNOTES

1. See the European Commission's "White Paper on Growth, Competitiveness, and Employment" (Brussels, 1993); and M. Bangemann et al., "Recommendations to the European Council: Europe and the Global Information Society" (Brussels, 1994). These documents are available online at *http://www.ispo.cec.be*. This site offers an excellent online collection of EU documents and directives on the broad area of the information society.

2. See Advisory Group on Internet in Europe, "The Future of Internet—What Role for Europe?" (1997), available online at *http://www.echo.lu/Legal/en/internet*. TEN-155, the successor of TEN-34, is now enjoying better success, partly because of an accelerating liberalization process in Europe (reviewed later in this chapter).

3. OECD, "The Role of Telecommunications and Information Infrastructures in Advancing Electronic Commerce," Working Paper on Telecommunication and Information Services Policies (background report for the 1998 OECD Ottawa Conference, Paris, 1998), available online at *http://www.oecd.org/dsti/sti/index.html*.

4. *Communications Week International*, 20 July 1998.

5. The issue of leased-line pricing has so far been addressed slowly in Europe: EU directives number 92/44 and 97/51 establish an obligation of transparent, non-discriminatory, and cost-oriented charges on operators having a "significant market power" in the supply of leased lines. Enforcement of this provision is in the hands of the various national regulators, which have not, so far, been very active on this issue.

6. See Network Wizards' Internet Domain Survey at *http://www.nw.com*. On this issue, see also OECD, "The Role of Telecommunications." According to these estimates, 1.8 percent of hosts were located in France, while 4.1 percent were in Germany, 1.1 percent were in Spain, and 1.2 percent were in Italy. Similar results are obtained looking at estimates on the number of users: see "Top 15 Countries with the Most Internet Users," *Computer Industry Almanac*, March 1998, available online at *http://www.c-i-a.com*. In early 1998, the United Kingdom had a 5.8 percent share of the world's total Internet users, while Germany had 4.1 percent, France 1.17 percent, Spain 0.9 percent, and Italy 0.8 percent.

7. See Robert Pepper, "The Internet: Foundation for E-Commerce," paper presented at the 1998 OECD/Osaka University Workshop; available online at *http://www.oecd.org/dsti/sti/it/index.htm*.

8. European Information Technology Observatory, *1998 Yearbook* (EITO, 1998), 380. Some of this information is available online at *http://www.fvit-eurobit.de*.

9. See again, Advisory Group on Internet in Europe, "The Future of Internet—What Role for Europe?"

10. See European Commission, Directive 97/96/EC Concerning the Processing of Personal Data and the Protection of Privacy in the Telecommunications Sector, 1997; available online at *http://www.ispo.cec.be/telecompolicy*.

11. OECD, "The Role of Telecommunications."

12. This policy change was mandated by the "full competition" directive, n. 96/19.

13. A recent official assessment of the state of liberalization in Europe has been provided by the European Communication Commission's "Third Report on the Implementation of the Telecommunications Regulatory Package," available online at *http://www.ispo.ece.be*.

14. For a detailed analysis of the case for centralization, see W. Lehr and T. Kiessling, "Telecommunication Regulation in the United States and Europe: The Case for a Centralized Authority," paper presented at the 26th Telecommunication Policy Research Conference, Alexandria, Va., 1998.

15. Lehr and Kiessling, "Telecommunication Regulation."

16. The text of the Treaty is available online at *http://europa.eu.int/abc/*.

17. See J. Pelkmans, "Regulation and the Single Market: An Economic Perspective," in *The Completion of the Internal Market*, ed. by H. Siebert (Mohr: Tubingen, 1990).

18. Bangemann et al., "Recommendations to the European Council."

19. See L. Prosperetti and M. Cimatoribus, "Andante ma non troppo: Telecommunications Liberalization Trends in Continental Europe," *Communications and Strategies* 31 (1998), 53–77, for a general discussion on the pace of liberalization in individual EU countries.

20. See European Commission Directive 97/96/EC.

21. OECD, "Implementing the OECD Privacy Guidelines in the Electronic Environment: Focus on the Internet," Committee for Information, Computer, and Communications Policy (September 1998), available online at *http://www.oecd.org/dsti/sti/index.htm*.

22. For a critical viewpoint of the United States' experience see M. Rotenberg, Testimony on the European Union Data Directive and Privacy, U.S. House of Representatives, May, 1998.

The Internet in the Other Three-Quarters of the World

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The Internet is the center of attention in the United States—on the stock market, in Microsoft and in small- and medium-sized enterprises, in Congress, in state governments, in classrooms, and in homes. This is also the case in many of the other 28 industrialized countries that, together with the United States, make up the Organization of Economic Cooperation and Development (OECD), countries such as Japan, Canada, the United Kingdom, and others in Western Europe. Indeed, more than 97 percent of all Internet host computers are concentrated in these 29 developed countries, which together contain less than one-quarter of the world's 5.6 billion people.[1]

This chapter focuses on the Internet in relation to the other three-quarters of the world: the majority of the world's population who live in the 129 developing countries,[2] presently served by less than 3 percent of all Internet host computers.

The chapter is organized into five sections. Section I presents data on living conditions and access to communications technology in developing countries. It shows the differences in access to health, education, and communication between the developing countries of Asia, Africa, Latin America, and the Caribbean, and the industrialized countries of the OECD. Section II addresses the availability and impact of older communication technologies in developing countries; Section III provides a taxonomy of Internet applications and addresses the interac-

tion of the Internet's technological capabilities and countries' ability and interest in taking advantage of them. Section IV describes seven obstacles to widespread Internet use in developing countries. Section V concludes the discussion by revisiting the question of basic disparities between developing and industrial countries in essential amenities for life such as water, sanitation, health, and life chances, and the ways in which these basic disparities parallel disparities in old and new communication technologies.

I. DEVELOPING COUNTRY POPULATIONS: THE OTHER THREE-QUARTERS

This section presents the general profile of deprivation for developing countries, and offers one set of explanations for this situation. Table 1 compares the most recent statistics (1995) on living conditions in both developing and industrial countries.[3] Developing countries average, per capita, a real gross domestic product (GDP) of $3,068 and electricity consumption of 814 kilowatt-hours, as compared to industrial-country equivalents of $16,337 and 7,542 kilowatt-hours.[4] While sanitation, water, health, and the chances of living until age 40 are not generally problems in industrial countries, about 58 percent of the population of developing countries lack access to sanitation; 29 percent lack access to safe drinking water; 20 percent lack access to health services; and 14 percent are not expected to live until the age of 40.

These averages conceal a lot: living conditions for all 4.4 billion who lived in developing countries in 1995 were not identical, any more than they were identical for the 1.2 billion who lived in industrial countries. Still, while people in many developing countries (particularly those who live in cities) are better off than these statistics suggest, populations of 48 developing countries (12 percent of the developing world as a whole) were substantially *worse* off in every way, as shown in the second column of Table 1, and more than twice as likely to die before age 40 than populations in the developing world as a whole. These 48 counties are the world's "least developed countries," a list that mostly includes the recently independent countries from Sub-Saharan Africa.

Having achieved independence from their colonizers relatively recently, many developing countries are generally young in comparison

with the United States' more than 200 years, and have had comparatively little time for systematic planning of their own futures, time that ranges loosely from 35 years in Africa to 50 years in Asia to up to 140 years in South America. In addition, the colonial heritage of most developing countries in Asia, Africa, Latin America, and the Caribbean is very different from the U.S. colonial experience or the industrial development experience of colonizing countries in Western Europe.[5] Today, all these younger developing countries are generally less wealthy than the United States, e.g., per capita real GDP is $355 in the Democratic Republic of Congo, $2,935 in China, $3,100 in Cuba, $3,801 in Jamaica, $3,971 in Indonesia, $5,928 in Brazil, and $22,604 in Singapore. While the developing world generally shares a history of colonization, contrasts between regions occur due to the different external and internal constraints individual countries have faced since independence, the timing and length of their colonization, the stage of development of their indigenous societies when invaded, and the administrative practices favored by the various colonizing powers. The similarities among developing countries arise from similarities in the purposes of colonization (primarily economic and strategic) and the investments made by the colonizers (generally scanty).[6]

Table 1: A Comparison of Living Conditions in Industrial, Developing, and Least Developed Countries in 1995

TYPE OF COUNTRY	Industrial Countries (pop. 1.2 billion)	Developing Countries (pop. 4.4 billion)	Least Developed Countries (pop. 542 million)
COMMUNICATION AND INFORMATION TECHNOLOGIES			
Radios per 1,000 people	1,005	185	113
Televisions per 1,000 people	524	145	32
Main telephone lines per 1,000 people	414	39	3
Cellular subscribers per 1,000 people	61	3.6	N/A
Personal computers per 1,000 people	156	6.5	N/A
Internet users per 1,000 people	18	0.5	N/A

Source: United Nations Development Program, *Human Development Report 1998: Consumption for Human Development* (New York: Oxford University Press, 1998).

Industrial countries with capital looking for overseas markets frequently encourage developing countries to open their markets to foreign investment. The 1997 *World Telecommunication Development Report* showed that after 44 developing countries let in foreign capital and privatized their state-owned phone companies, the number of people who had never made a phone call declined substantially from 7 out of 10 in the early 1980s to 5 out of 10.[7] Still, while increased foreign investment in particular markets such as telecommunications has increased the number of main lines in developing countries, the removal of barriers to foreign investment has not been accompanied by national policies and practices to stop the increase in inequality between the industrialized North of the globe and the less developed South.[8]

Together with the adoption of privatization and competition in all sectors of the developing world in the last decade, United Nations Committee for Trade and Development (UNCTAD) has documented a widening of gaps between the industrialized North and the less-developed South, and a widening of gaps between income strata within developing countries. One piece of evidence from the report is illustrative: in 1965, average per capita income of the Group of 7 industrialized countries was 20 times that of the world's poorest 7 countries; by 1995, the difference was 39 times as much. All developing regions have not been uniformly affected: the gap between industrialized countries and Africa, for example, has grown more rapidly than the gap between industrialized countries and Latin America. There are fewer countries in the middle-income group today than before: a few have moved upwards; many have moved backwards. This hollowing out of the middle class is mirrored within the developing countries, too, where the income share of the richest 20 percent has risen everywhere since privatization, deregulation, and the introduction of competition. Although profits have increased for the investor, this process has not led to more jobs.

These data are meant to set the context for a realistic discussion on the possible impact of the Internet in countries with very different economic base levels. These data are also meant to prevent facile generalizations about the power of the Internet from industrial-country contexts to the distinct contexts of developing countries.

II. TECHNOLOGICAL MYTHS, LEGENDS, AND LESSONS

In order to understand reasons for disparities both in the distribution of the Internet and in its potential impact, this section investigates the availability and contribution of the earlier information and communication media that are the basis of the Internet.

Table 2 shows that for every 1,000 people in developing countries in 1995, there were only 185 radio receivers, 145 television receivers, 39 main telephone lines, 3.6 cellular subscribers, 6.5 personal computers, and 0.5 Internet users. These statistics are averages: there are more cellular telephones in Thailand and more Internet host computers in Estonia, for example, than there are in Sub-Saharan Africa (not counting South Africa). The second column of Table 2 shows that the 12 percent of developing-country populations who live in the least developed nations are substantially worse off in terms of access to communication than the average for developing countries as a whole.

Table 2: Access to Communication and Information Technology in Industrial, Developing, and Least Developed Countries in 1995

TYPE OF COUNTRY	Industrial Countries (pop. 1.2 billion)	Developing Countries (pop. 4.4 billion)	Least Developed Countries (pop. 542 million)
COMMUNICATION AND INFORMATION TECHNOLOGIES			
Radios per 1,000 people	1,005	185	113
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Internet users per 1,000 people	18	0.5	N/A

Source: United Nations Development Program, *Human Development Report 1998: Consumption for Human Development* (New York: Oxford University Press, 1998).

What have we learned from the diffusion and use of stand-alone older media (e.g., radio, TV, print) whose capabilities are now present

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in converged form on the Internet? Four lessons stand out. First, the earliest media-effects research of the 1940s and 1950s in the United States tells us that media impacts are not inevitable, universally powerful, or direct. The impacts of communication are particular and contingent, not general and uniform.[9] The second lesson follows from the first: particular technologies are designed to solve specific problems (e.g., information transmission over the airwaves); most are not designed to be broad-based societal panaceas. Computer scientist Rob Kling is one of many who write frequently about how the news media casually promote images of a technologically rich future while ignoring the way in which new technologies can add cost, complexity, and new dependencies.[10] Such uncritical enthusiasm for technology does not take into account the social choices about *how* to computerize (or communicate) and the ways in which different forms of computerization (or communication) advance different values.

The third lesson focuses on the political reasons that account for why applications of communication media have rarely led to broad-based national development: technical failures and management problems are actually symptoms of the distribution of power in society. Five decades ago, in earlier, more naïve times, technologists argued plausibly that because the spread of information and communication channels would provide access to better information faster, the distribution of goods in society would therefore be changed. But the addition of an interactive communication capacity to a health project, for example, will not produce changes in health if variations in the success of treatment are due to lack of availability of reasonably priced medications or non-existent transportation to the hospital rather than to ignorant health staff.[11]

The fourth and final lesson about media impacts is from the social construction of technology (SCOT) research tradition and addresses options at the micro level. People do matter: individuals, social groups, and institutions in different times and places have major stakes and some choice in shaping the design, development, and application of technologies at the micro level. By studying the development of an active Internet culture in Kuwait and the persistence of traditional political and economic practices there, political scientist Deborah Wheeler showed how local cultural frameworks play an important and under-

recognized role in the kinds of practices enabled by networked communications and adaptations to the global economy.[12]

Since the Industrial Revolution, each new technology has been put on a pedestal as *the* solution to human needs in its day. To paraphrase Emerson, it would appear that technologies were in the saddle and ride humankind. Radio started out the same way in the 1920s, acclaimed as truly interactive, user-dominated, and user-controlled.[13] But gradually, as the airwaves became more popular, that precious interactivity was lost. Eventually, the spotlight moved on to black-and-white television, and then color television, cable, videocassette recorders, satellites, cellular telephones, personal computers, and now the Internet.

Is the Internet really different? Marjory Blumenthal's article in the present volume does an excellent job of presenting the uniquely general and flexible characteristics of Internet architecture without deifying it: unlike the narrow ways in which telephony and television evolved, she writes, the Internet Protocol (IP)—essentially a collection of software—supports a wide range of applications, uses non-proprietary standards, works on a wide range of communication devices and networks, and is serviced by a wide range of providers. Other Internet proponents further argue that the benefits of telecommunication-based innovations like the Internet include positive network externalities,[14] that is, that the Internet will increase in value as more users are added because each of the current users will now be able to access the newest.[15] But how will more users be added? The diffusion of the Internet is not automatic or determined; it will depend on private capital and state policy that choose from a competing range of possibilities for power and profit.

Consistent with Graham Murdock[16] and other communication sociologists, then, this chapter maintains that the Internet is *inherently* neither a technology of freedom[17] nor a technology of control;[18] it presents, more interestingly, new sites (Web and others) of struggle between contending forces, classes, and interests, most recently exemplified by the global struggle between public and private ownership of networks.[19] Applications and effects are not definitively determined by the technology or political economy alone, but are conditioned by the interaction of these and economic, political, and cultural forces at macro and micro levels. The effects of communication technologies are an amalgam of the possibilities in a particular time and place and of the inherent bias locked into the technology during the design process.[20]

Even before the arrival of the Internet, previous research taught us that the effects of communication technologies are complex, indeterminate, and ambivalent. In some times and places, telecommunication technologies have reflected and encouraged polarization between information haves and have-nots, and in other times and places, the same technological configuration has been used to empower the poor. Entertainment television can be used to educate and enlighten or to debase. Thus, the promise of the Internet Protocol is not inherently utopian *or* dystopian, any more than was the promise of radio. The Internet is an enabler; governments, businesses, and citizens' groups will introduce the technology to meet their own agendas. The Internet does not determine whether it will be used for applications to redistribute the wealth or concentrate it.

Given the unique flexible and general characteristics of the medium however, it is conceivable that the Internet may have wider societal impacts than the stand-alone media of the past. Its very flexibility could result in particular applications both benefiting some classes, groups, or agencies in a nation's power structure and offending others. For example, while the Department of Commerce in a given developing country might find the Internet facilitation of electronic commerce crucial, the country's Department of the Interior might be alarmed at the ways in which access to international e-mail and information allows news and views into the country that were previously disallowed, and might want to disable or hobble particular Internet applications.

III. APPLICATIONS OF THE INTERNET IN DEVELOPING COUNTRIES

Originating as recently as 1969 with the U.S. Department of Defense's ARPANET, the Internet has so far roughly doubled in size every year in terms of the numbers of its users. During 1998, *all* formerly "unconnected" countries got on to the Internet, making the international network nominally global. By July 1998, a small computer network of a few thousand users in the early 1980s had grown to some 36 million Internet hosts with an estimated 130 million users.[21] Especially in developing countries, there is plenty of room for Internet growth. But how will the Internet grow?

This section provides a taxonomy of Internet applications, and provides examples of how the technological capabilities of the Internet interact with a country's individual characteristics to influence which Internet applications will be privileged. Internet applications divide easily into the categories of communication, information, education, entertainment, and business and commerce. These are not exclusive categories; for example, all access is commercial in that accessing any application provides revenue to any number of people: the providers who get subscription fees, the designers of content, the advertisers who pay, etc.[22]

- *Communication.* Text, voice, graphics, video, electronic mail, videoconferencing, and Internet telephony are the basic Internet applications that have been universally embraced for corporate customer service and family maintenance. Several "free" e-mail services have emerged in response to this felt need that make their money off advertising to users while they compose their messages. For those with access to a personal computer, a modem, a telecommunications line, and literacy skills, "free" e-mail would appear to be the Internet application of the developing world. This will become even more true as lower-cost access devices are designed such as public personal digital assistants, screen phones (now under development by France Telecom, Alcatel, and Nortel Networks for the French market), and text-only interfaces for wireless access protocols.

  Western Union is reputed to have dismissed the telephone as inherently of no value in 1876. Similarly, telephone companies initially missed the implications of cellular transmission; the savvy ones are now making sure they do not miss offering Internet service. Nevertheless, some state telecommunication monopolies are trying to shut the door on Internet telephony.

- *Information.* This category includes electronic versions of newspapers, broadcasts, scientific and historical documents, court proceedings, government decisions, telephone directories, bulletin boards, and propaganda. Although the Internet transport system is capital intensive in developing countries, posting content on the Internet is not. Access to large amounts

of uncensored information is the application that is expected to enhance an informed democracy as individuals, organizations, and nation-states conflict with each other through the stories they tell. To illustrate, Amnesty International's list of human-rights violations by the Indian Army is counteracted by the Indian army's Web designer in Kashmir, who presents a very different story of murder, rape, and looting of property by "foreign" terrorists and mercenaries.[23] There have also been instances of groups defacing the Web sites of opposing groups.

- *Education.* Education on the Internet generally includes online courses of varying length that give the learner flexibility in terms of time, money, pacing, and study location. Traditional universities are expanding their markets by reaching out to students anywhere with degree and non-degree courses. New online branch campuses such as the University of Phoenix Online Campus and Michigan State Virtual University are competing with completely new virtual-only universities, all energized by new entities such as IBM's Global Campus program, which helps colleges put their courses online.[24] The television channel Discovery also has an online presence that provides access to courses, science news, and related information. Parents can enter a topic at the Discovery Web site, choose a grade level, and the site will recommend available resources on the Web.[25] The U.S. Public Broadcasting Service, like Discovery Online, uses its Web site to provide information to enhance its television programming.[26] This site also includes college telecourses and audio and video clips. This application could potentially energize millions of high-school graduates, particularly women who are not allowed to go to college in some cultures, through "virtual university" possibilities for lifelong learning.
- *Entertainment.* Entertainment on the Internet is an ever-expanding range of activities that include the ability to play games with competitors across the globe, watch and listen to entertainment television and radio online, watch made-for-the-Internet drama such as "The Spot" (debut 1995), and partici-

pate in virtual adventures through virtual trips to places like the Galapagos Islands or Antarctica.

- *Business and commerce.* The general category of online business and commerce includes traditional retail (e.g., virtual store fronts), alternative retail (e.g., online silent auctions), shipping (e.g., Federal Express), banking, insurance, and investment services. "Electronic commerce" once referred only to electronic data interchange (EDI) offerings and electronic messaging technologies that facilitated the exchange of business information, including e-mail, and fax. (The paperwork involved was reputed to have accounted for 7 percent of the value of total trade.) It is only since 1994 that traditional electronic commerce services have graduated to using a public network-based infrastructure such as the Internet.

Commercial transactions are now the fastest growing revenue-generator on the Internet. The global and national trade press outdo each other with stories of phenomenal growth: Amazon.com going from sales of $16 million in 1996 to $30 million a year later. Or 1-800-FLOWERS generating as much profit on 10 percent of total revenues as does nearly the total store-based business, which is twice as large. The owner of Bulky Sweaters of Nepal credits his 30 percent growth per year to the Internet: once importers from around the globe put their design specifications on the Internet, his software graphs it out so a local knitter can hand-knit a sample. The sample is then photographed. The photograph is scanned and e-mailed to the potential buyer. Once approval is received from the buyer, the product is completed and air freighted to retail outlets in less than a week. PEOPLink is a non-profit organization helping handicraft producers in developing countries all over the world market their products on the Internet.[27] They provide digital cameras to handicraft producers who can then e-mail pictures of their products for display on the PEOPLink home page for sale to retail and wholesale buyers in industrial countries.

Forrester Research predicts that by the year 2002, the value of such goods and services traded between companies over the

Internet will represent 1 percent of the global economy, approximately $327 billion.[28] Will developing countries benefit? The International Telecommunication Union (ITU) reports that 70 percent of U.S. firms are online, compared to 10 percent in Europe and only 1 percent in Asia-Pacific countries.[29] (A subsequent section of this chapter discusses how to address this problem.) Clearly, there are consumers with purchasing power in developing countries who want to be on par with their counterparts in industrial countries, for example, a middle-class population of 200 million in India and an equivalent if not larger group in the People's Republic of China.

Going beyond the technology itself, a conceptual framework informed by the literature on political economy and social construction enables us to flesh out the forces and factors that qualify and enable the Internet at the macro and micro level in each developing country, as the Internet contends with different realities "on the ground."

IV. WHERE THE INTERNET COMES DOWN TO EARTH

There were 0.5 Internet users per 1,000 people in developing countries in 1995, as compared with 18 per 1,000 people in industrial countries. This disparity is a clear reflection of a long-standing gap between developed and developing countries that reflects both a legacy of colonialism and previous rounds of capital accumulation.

The United Nations Commission on Science and Technology for Development has raised questions about the social and economic exclusion risks of the uneven diffusion of this technology.[30] One principal conclusion is that the costs of *not* using information and communication technologies to build national information infrastructures are much higher than the costs of doing so. Initiatives by the United States (Leland Initiative in Sub-Saharan Africa), Canada (Panasia Networking Program, Acacia),[31] Norway, and Finland address this fear. So do attempts by multilateral agencies such as the UNDP (Sustainable Development Network), the World Bank's Infodev and its African Virtual University, the UN Conference on Trade and Development (Global Trade Point Network, which links two million small and medium enterprises across the world), the ITU's EC-DEC (Electronic

Commerce pilot project for Developing Countries), regional efforts by the (British) Commonwealth of Learning and the Pan American Health Organization, nongovernmental organizations like the San Francisco–based Institute for Global Communications, and private foundations such as George Soros' Open Society Institute.[32] The London-based telecommunications venture-capital firm headed by Sam Pitroda has entered into joint ventures with developing countries to establish rural telecenters and government data networks.[33] U.S. economic geographer Barney Warf fears new telecommunication systems will lead to new rounds of uneven development and spatial inequality characterized by the growth of world cities, the expansion of offshore banking centers, the globalization of back offices and growth in a number of unexpected places, e.g. Hungary, Singapore, and the Dominican Republic.[34]

Building an Internet-empowered economy and democracy is more than a software development project. Common problems for African countries in 1996 listed by one study included incompatible equipment; poor access to consumables and peripheral equipment; shortage of funds; differences in communication systems; lack of trained capacity within existing institutions; poor collection, management, and diffusion of local content; and the absence of an enabling environment.[35] Some writers identify the major obstacle to Internet diffusion as pricing;[36] others focus on market structure;[37] and still others include the importance of several factors including gross domestic product (GDP) and bandwidth.[38] Bankers Trust New York lists impediments that are gradually being overcome such as limited phone lines, personal computers, per capita income, telecommunication and Internet service provider market structure.[39] One study has divided barriers to Internet diffusion into government policies, technical impediments, and local cultural factors.[40] Telecommunications engineer-turned communication researcher Carleen Maitland's very careful recent analysis of forces driving the diffusion of the Internet found economic factors to be the strongest predictor of adoption timing. She found the most powerful model included the variables teledensity (the strongest) followed by international calling costs and national scores on the Test of English as a Foreign Language.[41]

Infrastructural problems (e.g. electricity, teledensity, English-language ability) are more tractable in some countries than others. Economic hurdles such as low GDP are expected to be bigger long-term problems across

countries. Given the multiple applications of the Internet and hence its broader impact than previous stand-alone media, it is essential that more focused attention be given to this medium to avoid the poor diffusion of previous media.

This section presents a logical sequence of seven obstacles to Internet diffusion that need to be overcome. They include: low GDP; poor capacity to produce and consume electrical power; a limited local, long distance, and international telecommunication infrastructure; lack of necessary Internet hardware; rampant digital illiteracy; lack of local content; and state policies.

Obstacle #1: Gross Domestic Product

Differences in GDP do not explain all the differences in the rate of diffusion of the Internet; differential diffusion rates are evident among even the most developed countries. (Germany and France, for example, are much behind Finland in Internet access.)[42] Still, the first obstacle to investment in the developing world is low gross domestic product.

Researchers today do not make the mistake made by UNESCO communication practitioners in the early 1960s, who assumed that a high correlation of GDP with literacy, newspaper availability, radio receivers, and seats in movie theaters meant a one-way causal relationship in which the addition of more media would lead to higher incomes. Capital-intensive communication infrastructure, experience, skills, and knowledge in developing countries are also related to economic growth. The higher a country's income level, the higher the availability of safe drinking water, sanitation, health, telephone main lines, personal computers, and the higher the number of Internet users.

With a smaller percentage of middle-class consumers in many developing countries, the proportion of the Internet market to the total market is likely to be smaller than in industrial countries, a gap that is exacerbated by lower salaries and hence lower computer purchasing power. When 32 percent of the population live below the $1-a-day income poverty line, what should the average developing country invest in first: food, clothing, shelter, or an Internet backbone and public access centers? The answer is surely not "which first?" but "how much of which under what conditions?"

Obstacle #2: Electricity

The second largest obstacle to Internet diffusion is the electricity infrastructure. The Internet Protocol runs on computer networks, which run on electric tracks. The ability of developing countries to leapfrog to the information age is constrained by their lack of this prior infrastructure that provides the energy for the telecommunication system and Internet host computers.

Total electricity consumption by the more than three-quarters of the world's population living in developing countries is approximately one-third of the total electricity consumed by the population of the industrial countries. Thus, the average number of kilowatt-hours consumed by the average person in developing countries is only 814 while the average person in industrial countries consumes 7,542 kilowatt-hours. (See Table 1.) South Africa is experimenting with solar-panel-generated electricity for public-access community telecenters that is sufficient to supply lighting for four hours per evening to run a TV, an overhead projector, and a personal computer.

Obstacle #3: Infrastructure

The third obstacle to Internet diffusion in developing countries is the limited local, long distance, and international telecommunication infrastructure itself. The causes of this shortfall are historical and contemporary, public and private, economic and political.[43]

There are only 39 main lines and 3.6 cellular mobile subscribers per 1,000 people in developing countries. Regional disparities are high within this three-quarters of the world: Sub-Saharan Africa has 12 main telephone lines per 1,000 people while East Asia (excluding China) has 304 main lines.

Present telephone bandwidths in developing countries can barely handle standard usage patterns for voice communication in terms of call duration and redial attempts. When traffic from faxes and Internet telephony increase, the demand for access will be many times more than at present. Upgrading the network and using bypass alternatives such as cable, satellite, and wireless will become essential.[44] Technology to route Internet traffic around the telecom company switch will be crucial to avoid a local switch being open for many hours merely to accommodate low-profit data traffic. Twisted-pair copper will have to be

replaced by ADSL (Asymmetric Digital Subscriber Line) technology, cable modems, satellite, and wireless to efficiently handle the bandwidth demands of multimedia applications.[45]

Several improvements in telecommunications infrastructure have already been made: as noted earlier in this chapter, when *The Missing Link*, Donald Maitland's report to the ITU, was published in 1984, Maitland reported that 7 out of 10 people in the developing world had never made a telephone call. Forty-four privatizations and a dozen years later, the figure had dropped to 5 out of 10. Mohammed Yunus, founder of Bangladesh's Grameen Bank, has successfully demonstrated how low-cost mobile telephony can be provided to every village. PPPShar, a software package made in India, allows a number of users on a customer's network at one location to make use of the same telephone line and modem, saving on telephone charges and subscription fees to Internet Service Providers (ISPs).

Internet connections have now expanded beyond universities and research institutes to the general public in cities in developing countries through flexible pricing plans based on variations in type of application accessed (e.g., e-mail only), time of access, and length of access. Rural users are few. As developing countries begin to allow competition in local, long distance, international and ISP markets, prices have been coming down. Unfortunately, U.S. carriers charge foreign ISPs the full circuit cost of international leased lines to U.S. Internet backbones, unlike the voice telephony practice of splitting the costs of an international circuit between the two countries that are connected. The lack of low-cost regional IP backbones and the high demand for access to U.S. content forces developing countries to go through the United States to communicate with each other. Because a foreign ISP has fully paid for the bandwidth, U.S. traffic gets a free ride on the circuit in both directions.[46]

Obstacle #4: Hardware

The fourth major hurdle to Internet diffusion is availability of personal computers with modems. Compare the 156 computers per 1,000 people in industrial countries to the 6.5 per 1,000 figure for developing countries.[47] While computer costs are declining, a major factor in Internet diffusion may be television. The increasing convergence between TV and the Internet means the day may not be far off when all

TV sets will be Internet-ready straight from the factory. (WebTV is positioning itself to be a major content provider.) Only a small proportion of high-tech users who want the latest technology and connectivity will stay with PCs equipped with high-speed modems. Indeed, since mid-1997, the ITU has maintained that projections for Internet growth need to be based on a mass-market model like television rather than on computers or telephones. Given the comparatively large number of television receivers in developing countries (145 per 1,000 people), Internet access through TV may become a major factor. Other low-cost mass-market terminals for Internet service could be smart telephones in public kiosks run by small businesses.

Obstacle #5: Digital Illiteracy

A fifth obstacle to Internet diffusion is the lack of technical education of both providers and users. The trained staff needed to design national policy or run ISP firms is woefully limited and inadequate in developing countries. And while it is possible to develop user interfaces that are graphical, it is unlikely that this will happen.

The UNDP reports that adult illiteracy is minimal in industrial countries. The percentage of total illiteracy in developing countries ranges from 6 percent in Eastern Europe to 13 percent in Latin America, 19 percent in China, 21 percent in the Caribbean, 46 percent in Southern Asia, and 45–50 percent in the Maghreb, other parts of North Africa, and Sub-Saharan Africa. In general, the illiteracy rate in developing countries for women is higher than it is among men; in some places, women are not entitled to public education at all. In other places, people of particular ethnic, religious, and caste backgrounds face discriminatory access. Because digital literacy is an additional requirement over and above general literacy, these hitherto-excluded populations will be excluded from the Internet, as well.

The good news is that general literacy rates in the developing world have been increasing fast, to the point that digital literacy may not be a major obstacle in the next decade. Given skilled teachers and capital, developing country governments will be in a position to model the "Netdays" initiative by the European Commission to raise consciousness about the educational applications of the Internet in schools, libraries, youth organizations, and hospitals.

Obstacle #6: Content

The sixth hurdle to widespread diffusion of the Internet for average residents of developing countries is the lack of suitable content that addresses their pressing daily needs for food, water, clothing, and shelter. U.S. phone companies and ISPs know that just because they can deliver hundreds of channels doesn't mean they can deliver anything worth watching for skeptical mass audiences.[48] This is also an issue for the older media in developing countries, such as print, radio, and television. Where relevant information exists, it is not free or widely accessible. Given the world-wide trend toward liberalization, the earliest organizations to host Web sites have been national central banks, financial institutions, and domestic firms trying to woo foreign investment. Some multimedia Web sites feature corporate window dressing, public-relations attempts at image creation that frequently have less information than is available from other more accessible sources such as printed brochures and books.

People with the skills to present domestically relevant information in a new technical format for the Internet are not difficult to find within developing countries. Many industrial countries are outsourcing their work to data-entry persons, artists, and designers in developing countries. The crux of the matter is ownership of the data: developing countries do less research than industrial countries, irrespective of the form in which it is shared. Inequalities in R&D spending between countries exceed inequalities in national income, according to the World Bank's 1998–1999 *World Development Report*. Regional differences in information-production capability within developing countries will be reflected in this new medium, too.

English dominates on the Internet. Searches on the Internet in a few European languages are now being offered by some search engines; for example, search capability in Estonian, which is spoken by less than 2 million people, is offered by Alta Vista. The People's Republic of China has launched a China-only low-cost Internet service with expanded Chinese-language content in an attempt to restrict the vast majority of China's Internet users to domestic Web sites.[49] Chinese-language search engines (e.g., Sohoo and Yahoo Chinese) help find Chinese-language information on the Web. Many Chinese-language newspapers are now online. The dominance of English on the Internet is being counteracted through initiatives in other countries to provide incentives for national

language databases. Microsoft has launched local language versions of its MSN.com directory site in twenty-four countries. Examples of the rich cultural heritage of the world available on Web sites are increasing: one Web site presents Arabic cinematic history from 1924 to 1995 through video and audio clips. India's Department of Electronics has sought to promote the development of national content, services, and connectivity through its Educational Research Network and its National Informatics Center Net (NICNET) that connects all federal, state, district, and village-level planning offices.

Some criticisms of the Internet charge that its users are predominantly men and that content is not organized to suit women's ways of knowing. Men predominate in older media content production, too, in Hollywood film studios and U.S. television networks. Indeed, MTV has come under scathing criticism for presenting the dream world of older white male producers and writers in the United States. Given the lower general literacy levels of women in developing countries and hence their lower digital literacy, state policy is essential to ensure that the Internet does not merely reflect the gender divide in society rather than address it. In the United States, the "digital divide" between certain groups of Americans has increased since between 1994 and 1997, for example, those at upper and lower income levels. Blacks and Hispanics now lag even further behind whites in their levels of personal computer ownership and online access.[50]

Obstacle #7: The State

The Electronic Frontier Foundation maintains that information is inherently free and that a network of networks like the Internet is designed to route around attempts to impede its free flow. Nevertheless, many nation-states have been trying to ensure surveillance of users by imposing restrictive policies on Internet Service Providers (license fees, foreign ownership limitations, traffic monitoring requirements), artificial distinctions between telephone lines and computer networks, time-sensitive tariffs for access to the Internet. Other issues include national security concerns about encryption and fears about public decency and the protection of children from pornographic information.

Few of today's Internet policy-making institutions provide a means for input from developing countries since the Internet is mainly based in the West.[51] And developing countries often have a different point of

view on the Internet. It is not unusual to read of governments attempting to penalize those who have made particular postings to newsgroups. The People's Republic of China has attempted to control Web sites in the country by blocking access to the Internet through government computers. Lin Hai, owner of a Shanghai software company, was given a two-year prison sentence after a secret trial for exchanging e-mail addresses with an offshore dissident magazine group. [52] It is not so long ago that churches and libraries in the Western world burnt books and imprisoned their writers for content that went against their beliefs.

Nonprofit civil-society organizations at the international and national levels have demonstrated impressive Internet-use skills in participating in global decision-making. A recent successful attempt was global opposition to the draft agreement on Multinational Agreement on Investment under discussion in the OECD; the discussion was withdrawn. Volunteers in Technical Assistance runs discussion groups and projects to ensure inclusion of rural areas of the world through the Internet.[53] Given the dominance of developing countries' civil-society organizations that support the status quo (e.g., denial of equal rights to women and particular ethnic groups), it is as likely that they will use the Internet faster and with greater facility to support their goals than will oppressed groups.

V. PROGNOSIS FOR THE INTERNET IN DEVELOPING COUNTRIES

The Internet is not ubiquitous, and will not be for a long time. The lack of privatization and competitive markets in developing countries contribute to this region's high cost of international service and low access to the Internet. This trend is further exacerbated by the common business practice that ISPs in developing countries pay for the full cost of leased lines to the United States even to contact neighboring countries. The result for the present is slow growth of a skewed Internet market with a small number of users concentrated in a few large urban centers.[54]

Many parts of the world do not yet have radio receivers, TV sets, and telephones. Those parts of the world that do have these technologies of communication are likely to continue to use "unconverged" applications of these single modalities for a long time. It is conceivable

that a few parts of the world will leapfrog from no conventional media (e.g., radio and television) to multimedia content on the Internet.

To those that "have" (e.g., purchasing power, electricity, telecommunication infrastructure, computers or newer Internet smart terminals, and digital literacy), more is likely to be given through the Internet. Canadian telecommunication professor Robin Mansell has systematically shown how new digital telecom networks are designed to further the strategic goals of large service providers and large users rather than provide access to all.[55] Internet access in developing countries is likely to reflect pre-Internet distribution of economic power around the world, e.g., the previously noted fact that 70 percent of U.S. firms are online compared to 1 percent of Asia-Pacific firms. Still, developing countries are not monolithic: uses and applications of the Internet are likely to reflect variations in economic power and existing economic, political, and cultural forces on the ground.

Business and commerce applications are likely to drive the Internet in developing countries as they do elsewhere. This phenomenon will result in advances in technology for commercial access, corporate content development, and security of transactions. Such applications will be energized and supported by the state since the focus of each state is on growing national enterprises into global champions. Malaysia, Singapore, Ireland, and India provide examples of state support for corporate information technology applications. As is predicted for developed countries, use of the Internet in developing countries is likely to change the way business is done, which will allow entrance to newly nimble players and result in the possible demise of the less innovative.

A spin-off of business development applications is likely to result in greater access to e-mail and other communication possibilities for individuals, groups, and nongovernmental organizations. Greater access to information on governmental decision-making is likely to become a two-steps-forward, one-step-backward process, alternating between challenges to state power and crackdowns by the state against challengers. Conservative civil-society organizations and related political parties in developing countries are likely to try to filter Web content, just as conservative groups in the United States seek to do. Countries without constitutional free speech guarantees may have more success in blocking access to some Web sites as the technology improves.

The nature of Internet service for those without purchasing power, electricity, telecommunications infrastructure, smart terminals, and digital literacy is likely to be very different from household access envisaged in industrial countries. Cybercafes and roadside telecenters with telephones, fax machines, computers, and Internet connectivity for e-mail are likely to be the norm, with access to the World Wide Web where there is sufficient bandwidth.[56] For the expanding middle class in many developing countries, Internet access may be very similar to that of their counterparts in industrial countries.

ENDNOTES

1. See Network Wizards at *http://www.nw.com* and the ITU World Telecommunication Indicators Database at *http://www.itu.int*.

2. United Nations Development Program (UNDP), Human Development Report 1998: Consumption for Human Development (New York: Oxford University Press, 1998).

3. Terms such as "industrial countries," "developing countries," and "least developed countries" (LDCs) serve to distinguish countries by levels of economic activity, as published in the UNDP's *Human Development Report 1998*. The term LDCs was originally coined by the United Nations in 1971 to describe the "poorest and most economically weak of the developing countries, with formidable economic, institutional and human resources problems, which are often compounded by geographical handicaps and natural and man-made disasters." In that year there were 21 LDCs. By 1996, that number had grown to 50, 36 of which were in Africa. These countries, with a combined population of approximately 542 million people, comprise slightly less than 1% of the world's population and roughly 12% of the population of the developing countries. Examples of industrial countries include: Canada, Germany, Japan, South Korea, the United Kingdom, and the United States. Examples of developing countries include: Brazil, Jordan, Malaysia, Mexico, Namibia, Poland, and Thailand. Examples of least developed countries include: Bangladesh, Bhutan, Cambodia, Ethiopia, Haiti, Mali, Nepal, Senegal, and Uganda.

4. U.S. per capita equivalents are $26,977 in real GDP and 12,660 kilowatt-hours. The earth's energy resources are not adequate for all countries to use electricity at U.S. rates.

5. Nepal, Thailand, Bhutan, and Iran were never colonized.

6. See Paul Cammack, David Pool, and William Tordoff, *Third World Politics: A Comparative Introduction* (Baltimore: Johns Hopkins University Press, 1988).

7. International Telecommunication Union (ITU), *World Telecommunication Development Report 1997* (Geneva: ITU, 1997).

8. United Nations Committee for Trade and Development (UNCTAD), *World Trade and Development Report 1997* (Geneva: UNCTAD, 1997).

9. Shearon A. Lowery and Melvin L. DeFleur, *Milestones in Mass Communication Research: Media Effects* (New York: Longman, 1995).

10. Rob Kling, "The Seductive Equation of Technological Progress with Social Progress," in *Computerization and Controversy* (San Diego: Academic Press, 1996), 22–25.

11. Robert C. Hornik, *Development Communication: Information, Agriculture and Nutrition in the Third World* (New York: Longman, 1988).

12. Deborah L. Wheeler, "Global Culture or Culture Clash," *Communication Research* (August 1998).

13. See Todd Lapin, "Déjà Vu All Over Again," *Wired*, May 1995, 175–177, 218–222, for a readable account of the similarity of the hype surrounding radio in the 1920s and the Internet today.

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23. See Amnesty International at *http://www.amnesty.org*. and the Indian Army's Web site at *http://www.nic.in/armedforces/army.htm*.

24. See the University of Phoenix Online Campus at *http://www.uophx.edu*; Michigan State Virtual University at *http://www.vu.msu.edu*; and IBM's Global Campus program at *http://ike.engr.washington.edu/igc/*.

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45. With 600,000 cable TV operators in India, Silicon Graphics India Limited have created a separate group to address opportunities in this business on the assumption that at least 1 percent of them would be capable of offering Internet service.

46. The Asia and Pacific Internet Association report prepared for the Asia Pacific Economic Council in September 1998 estimates that foreign ISPs subsidize U.S. telecom operators by as much as $5 billion per annum.

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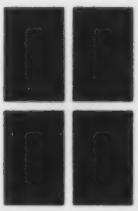

BUSINESS ON THE NET: A PRIMER ON THE NEW REALITIES

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It's unavoidable. Internet companies are in the news every day now—whether incumbent monopolists or IPO (Initial Public Offering) wannabes. They're where the action is! They're shaping the future! They're the darlings of the stock market and the masters of the cyberuniverse! As much as you may want to avert your eyes from all this cyberflash, if you're in business you can't help but ask: "What does all this mean? Why are all these people banking on 'electronic commerce?' Do I need to take this seriously, or is it all smoke and mirrors?"

You're not alone. Business executives everywhere are trying to assess "what it all means" and what it means for their companies. Companies large and small that aren't yet online are asking themselves how they should proceed. Is the jump online just a defensive play or are there real opportunities? How much is hype and how much is hope? This chapter is a short guide for the perplexed.

What is electronic commerce ("e-commerce") all about? What issues should managers be thinking about and what challenges will they face? Although e-commerce is new, and projected to grow extremely rapidly, it is not entirely new; nor does it exist in a vacuum. Instead, e-commerce is a subset of several broader developments in business. If widely adopted, it will have foreseeable consequences for current business models. And, like every other type of commerce, it will be subject

to external constraints in the form of international regulation, laws, taxation, and considerations of culture and politics.

Electronic commerce provides significant new opportunities for business efficiencies and expanded markets, puts pressure on traditional channels of distribution and corporate structures, and, arguably, creates patterns of buying and selling analogous to those in a bazaar. Business managers need to promptly rethink traditional ways of doing business to address these rapidly emerging new realities.

WHAT IS ELECTRONIC COMMERCE?

First things first: what, exactly, is electronic commerce? Unfortunately for those who seek clarity and precision, the term "electronic commerce" is a very elastic phrase, used with a wide variety of narrowly focused and broadly encompassing meanings.

In its broadest construction (one that is commonly used), electronic commerce is any business transaction in which any form of electronic communications plays any role. Using this definition, all companies that use telephones, cellular phones, faxes, credit cards, e-mail, private computer networks (Electronic Data Interchange [or EDI] systems), automatic teller machines, etc., already engage in some degree of electronic commerce. From this perspective, electronic commerce adds up to very large numbers indeed, such as $1 trillion in transactions by the year 2002.[1] When figures such as this are mentioned, it is very important to be clear about what exactly is being measured or predicted: all transactions with an electronic component? all transactions involving the Internet? all transactions conducted primarily over the Internet? all new transactions over the Internet? Unfortunately, companies providing statistics are rarely so kind as to be sufficiently specific about their points of reference, and so there is likely a good deal of mixing of "apples and oranges" when comparing estimates.

Many analysts instead consider e-commerce to be only those transactions actually carried out on the Internet. But while an overly broad definition of e-commerce obscures distinguishable trends, an overly narrow definition misses some of the ways in which consumers actually make purchasing decisions. For example, many consumers research

their purchases online and then buy in some other way (which may also account for some of the variation in forecasts).

In one matter of common, if fuzzy, agreement, "electronic commerce" is typically divided into two categories: business-to-business ("B2B") transactions and business-to-consumer ("B2C") transactions (ignoring, for the moment, transactions between business and government).

B2B: Big Numbers, But How Much is New?

Mirroring the "real" world, the estimated dollar value of Internet B2B transactions is projected to be five to ten times as great as B2C sales.[2] This relationship is consistent, although current estimates and projections vary. According to Forrester Research, a major independent research firm specializing in the impact of information technology, the business-to-business market for e-commerce overshadowed the business-to-consumer electronic marketplace by $7.9 billion to $2.5 billion in 1997, and the gap was projected to widen. In 1998, according to Forrester Research, business transactions were expected to outweigh consumer transactions by $17.3 billion to $5 billion. By 2001, the gap is expected to expand dramatically, by $186 billion (B2B) to $18.4 billion (B2C). Another well-known independent consulting firm, The Yankee Group, forecast that B2B commerce would hit $34 billion in 1998, and then multiply to $170 billion by 2000, while B2C sales would hit $5 billion in 1998 and merely double, to $10 billion, by 2000.[3]

Initial year-end figures for 1998 retail electronic commerce were released on 5 February 1999 by U.S. Secretary of Commerce William M. Daley, who noted that estimates ranged from $7.4 billion to $13 billion, for an average of $9 billion. Overall B2B figures for 1998 were not available as of that date. These numbers, if confirmed, suggest that many estimates of electronic sales to consumers may have been too conservative. Secretary Daley further predicted some $30 billion in retail sales in the year 2000.[4]

One important point underlies all these forecasts: *much of the total rise in B2B dealings will result from a switch in the methods by which current dealings already take place*. The overall growth in total commerce by all methods will be much lower. This introduction of electronic methods of doing business will not be new to many executives;

almost three-quarters of companies that took part in a recent survey were already using electronic data interchange to link their financial systems and to automate billings and payment with their suppliers and customers.[5] Until recently, EDI was the primary way businesses conducted electronic commerce, even though they had to create private networks and learn difficult software. Worse, although EDI has been around for about twenty years, it still lacks common standards and can be both expensive and complicated to implement, which has kept many small businesses from installing it. Furthermore, while EDI has made the supply chains of big businesses far more efficient, it has not transformed the marketplace: by and large the same companies are selling the same things to each other, just faster and more cheaply.[6]

So there's plenty of room for growth. Indeed, only 3 percent of all B2B Web sites were designed for direct sales by the end of 1997, according to Forrester Research. And although 80 percent of America's Fortune 500 firms had Web sites by the end of 1997, compared with only 34 percent a year earlier, only 5 percent were conducting transactions on the Web.[7] Instead, their stated reasons for setting up Web sites were to provide information about their wares and to help their customers.

B2C: Electronic Retailing ("E-tailing")

Estimates of Internet retail sales ("e-tailing") vary considerably (again, due to measurement and definitional issues), but all sources agree they are rising sharply. However, to put them in perspective, the total scope of the U.S. retail economy is estimated at about $2.5 trillion; and while catalog sales alone accounted for $51 billion in 1997,[8] one projection of e-tail sales for 1998 was $13 billion.[9] The same study asserted that the top four categories (computer goods, entertainment, travel, and discount brokerage) would account for 80 percent of the revenue in 1998, with ten Web sites (unspecified) accounting for 50 percent. Nearly 60 percent of e-tail revenues, it projected, would be generated by "established retailers," and those revenues would largely represent new customers, not customers taken from stores and catalogs.[10] By way of comparison, another study estimated year-end 1998 sales at $4.5 billion and year-end 2002 sales at $35.3 billion.[11] And although it has become "traditional" to exclude the "adult entertainment" online busi-

ness from these figures, estimates of its current annual revenue are in the billions of dollars.

A study by Nielsen Media Research and CommerceNet reports that the base of online purchasers doubled from 10 million to 20 million from September 1997 to June 1998, and that the United States was responsible for generating 85 percent of total retail e-commerce in 1997. U.S. retailers estimate that it will be 2001 before the proportion of customers outside the United States reaches 30 percent.[12]

That said, no one can be certain quite how large the potential is for B2C e-commerce. The Organization for Economic Cooperation and Development (OECD) estimates that within five years (from 1998) up to 15 percent of global retail sales could take place over the Internet.[13] In a survey by CommerceNet and Nielsen published in early 1998, 73 percent of Internet users had used the Web for shopping on one way or another in the preceding month.[14] According to projections by International Data, 46 million consumers in America alone will be buying online by 2000, spending an average of $350 each per year, for a total of about $16 billion.[15]

Of consumer-directed businesses, only 9 percent had sites offering online transactions in 1997.[16] The CommerceNet/Nielsen survey found that although 53 percent of Internet users in the United States and Canada had used the Internet to reach a decision on a purchase, just 15 percent had carried out their final transactions on the Web.[17]

All of the data suggests that we are at the "pioneering" or "discovery" stage of Internet e-tailing and e-commerce development. If this analysis proves true, and more and more business moves onto the Internet, e-commerce will raise significant issues and challenges for management.

EMERGENCE OF A GLOBAL MARKET FRAMEWORK

Three major long-term global trends are influencing the growth of electronic commerce: globalization, the worldwide use of electronic transfers of funds and cash, and the rapid expansion of the Internet.

WTO Rules: The Globalization of Commerce

In recent years, the World Trade Organization (WTO) has successfully promoted both the concept of free trade in goods and services and the lowering of international trade barriers—usually with the strong support of the United States and international financial institutions. This program has been especially true in areas key to electronic commerce: information technology, basic telecommunications services, and financial services.[18] The OECD has been even more aggressive in this regard.

Open markets have meant the privatization of formerly government-controlled industries, deregulation, and competition.[19] Accordingly, international commerce has flourished, and trade between nations has steadily risen. Government bureaucracies have been constrained from over-regulation and a global consciousness has arisen of the need for uniform trade policies (albeit with some accommodation for transition from former command economies and for developing nations). This shared vision has provided the regulatory basis on which the foundation for global electronic commerce is being built.

Borderless Bucks—Electronic Money Flows

With an integrated global financial Web and twenty-four-hour trading markets (always open somewhere) capital flows freely, by and large, across borders and around the world seeking profits—sometimes through speculation that is little more than gambling, sometimes through farsighted long-term investment strategies. Major banks, investment houses, brokers, and financial institutions operate on a global basis and serve clients in many countries. Corporations can make internal transfers effortlessly, and anyone holding a major credit card can use it in nearly any major city anywhere.

Some observers argue that the ability of capital and cash to flow so easily has eroded the concept of national sovereignty in reverse proportion to the level of control that most countries formerly exercised over their domestic economies.[20] Now investors/speculators can (and do) move in and out overnight, which can create, some nations have alleged, a destabilizing effect on national and regional economies. Likewise, transnational corporations can, with relative impunity, move facilities or

use electronic transfers to avoid costs and reduce taxes or to relocate various aspects of production.

This mobility has laid the groundwork for new forms of electronic money transfer, which, when combined with "smart cards," will allow international buying and selling quickly, efficiently, and securely, any time, and from nearly any location.[21]

Just Another Thread in the Web

Into this mix of global trade and finance has come the Internet, a relatively recent development. It is not the purpose of this article to trace the history, technology, and uses of the Internet.[22] Although originally developed for more narrow purposes, the Internet is evolving into a global, all-purpose digital information network that dispenses voice, video, multimedia, and data with equal equanimity and has the potential to provide a vast array of services including information, entertainment, education, health, government benefits, and others. Companies have now recognized that this tool may also be useful to them in the conduct of their business, both as a replacement for pre-existing systems (e.g., computer local- and wide-area networks, telephones, fax machines) and for its unique added functionalities.

Statistics about the Internet are more reliable as directional indicators than as specific "snapshots" of a moment. Numerous barriers prevent precision, not the least being that the Internet continues to be a rapidly moving target with a technology that does not easily lend itself to "counting." Estimates of the Internet's current size and future growth vary both by differing definitions of what is being counted, and by differing techniques of sampling and projection.

On 18 April 1998, the U.S. Department of Commerce released "The Emerging Digital Economy Report" ("the Report"), which set forth the U.S. vision of the future of electronic commerce: a future of opportunity and prosperity.[23] After noting that reliable statistics are hard to find, the Report estimated that, by the end of 1997, more than 100 million people worldwide were using the Internet. If current trends continue, it said, information technology and electronic commerce can be expected to drive economic growth for many years to come. The Report predicts that by 2002, the Internet may be used for more than $300 billion worth of commerce between businesses, and it cites some experts'

belief that as many as one billion people may be connected to the Internet by 2005.[24]

It is useful, in this regard, to recall that the Internet was "born American"; the U.S. government played a major role in its development, and English is its "native" language. Further, the United States and Canada still constitute the largest presence on the Internet, accounting for 84 percent of users (United States, 75 percent; Canada, 9 percent),[25] 93 percent of electronic commerce (United States, 85 percent; Canada, 7 percent),[26] and 66 percent of hosts (United States and Canada combined).[27] But rapid growth is currently under way in the European Union and the Asia-Pacific economies. By the year 2005, for example, according to the consulting firm Computer Economics, the second-largest projected Internet-using country in the world will be China (37.3 million), followed by Japan (34.7 million), Germany (17.5 million), and Canada.[28]

INFORMATION TECHNOLOGY AND CORPORATE REENGINEERING

As the larger world changes in ways that make electronic commerce feasible, a rethinking of the ways in which corporations are structured is playing a key role in its implementation. Within corporations, information technology (IT) is being used to integrate virtually every key corporate function: manufacturing, finance and accounting, sales, marketing, human resources, and supply-chain management. This integration is tied into the concept of reengineering, of saving money by streamlining operations; its technology is called "enterprise software."

Installing a full-fledged enterprise software system can cost a Fortune 500 company $30 million in license fees and $200 million in consulting fees (not including millions of dollars in additional computers and networks) and can take three years or more to implement. When enterprise software was first developed, it was directed at internal management. Now, competitors in the enterprise software industry are creating a new market by selling programs that expand the focus of enterprise software outside the company to the Internet, making it easier for businesses to spur revenue growth, get the most out of customer data, and manage relationships with suppliers and consumers.[29]

Concurrently, scores of vendors are offering software packages that electronically link companies to their customers, dealers, and suppliers,

including front-office applications that help companies find and sell to new customers, and software products that help companies better analyze operations to unearth new profit opportunities with present customers.

Products closest to the cutting edge are applications that help companies sell over the Web. Calico Systems in San Jose, for example, sells a program known as a *configurator* that helps a company selling its products on the Web do one-to-one marketing. This configurator is a simple, elegant front end that lets customers equipped with nothing more than a browser tap data embedded in other enterprise applications. Thus, for example, visitors to Dell Computer's configurator-equipped Web site can reach into Dell's internal enterprise applications and configure their own unique personal computers with specific hard drives, modems, processors, and so on.[30]

So far, the use of proprietary enterprise software has primarily been by large, global corporations. The concept of using information technology to integrate various business functions in real time on the same network is, however, one that is applicable to many more businesses. To the extent that the concept is progressively implemented, it provides an internal data structure to which corporate Web sites can be interconnected. For the definitional purposes of this chapter, enterprise software itself is not "electronic commerce," but the functionalities it provides can be integral to a fully developed e-commerce system. Enterprise-type software is not necessary for engaging in electronic commerce, but it is important to maximizing its value.

STRUCTURAL AND OPERATING BUSINESS ISSUES

These developments—globalization, the internationalization of finance and banking, and the rapid deployment of the Internet, all combined with the increased use by corporations of information technology in the context of business process reengineering—imply significant changes for traditional, well-established business practices and patterns.

The Death of the Salesman?

There are a number of reasons businesses go online, and a number of ways in which to do it. Levels of sophistication (whether B2B or

B2C) range from a simple, non-interactive, informational Web site to one that is fully integrated for interaction with customers, vendors, and others, as well as with the necessary back office and support services. The most sophisticated Web sites can be effective for selling, but, to the extent that they are, they may bring undesirable consequences for existing relationships with employees, agents, and others.[31] For example, selling directly to consumers over the Internet may undercut a company's own sales force or its relationship with its distributors and retail outlets.

The first, and worst, reason for going online is purely defensive. "Our competition has a Web site," says the boss, "so let's put something up there." This approach is the least likely to lead to benefits, and the most likely to produce frustration and disappointment: "Well, we went online and nothing happened. What a waste of good money!"

A more positive, but still simple, approach is to produce a Web site to serve customers with product information and interactive e-mail. This can positively influence purchasing decisions, take some load off call centers, and enhance customer relations—but only if it is done on an active, real-time basis. Information needs to be current, and customers should get responses to e-mail within twenty-four hours. If not, you've just created a new source of ill will.

From this point on, additional complexity is a function of integration and automation. The ability for customers to place orders online can be customized to meet current and future customer needs and integrated with purchasing/procurement, tracking, reporting, invoicing, and payment systems, all of which can result in lower purchasing costs, reduced inventories, lower cycle times, more efficient customer service, lower sales and marketing costs, and new sales opportunities.

The Internet's potential to wring costs out of the distribution system is understandably a concern to current salespersons and distributors, and many companies are concerned about upsetting critical long-term relationships with important channels of distribution, creating a classic "channel management" problem. To offset the differential in costs, some companies are intentionally pricing products higher online (an act counter-productive to the virtues of the Internet); others are offering sales staffs compensatory commissions on Internet sales.[32]

The jury is still out on the question of the extent to which Internet sales will "cannibalize" existing channels, both in-store and catalog sales. But over the long run, the ability of a well-designed and well-managed Web site to compress transaction costs and respond to customer demand

faster, better, and with more flexibility, offers a significant advantage. In the long run, the viability of traditional channels of distribution will be challenged.

At the most sophisticated level of development, the Web site can be integrated with the corporate extranet, intranet, and IT system, allowing suppliers, customers, professionals, and others access to all relevant information in real time, thus creating opportunities for more integrated customer relationships and more efficient, lower-cost responses to needs from suppliers. Integration with existing EDI and CAD (Computer Assisted Design) systems, where appropriate, can even allow joint product design.[33]

Up the Virtual Value Chain

As noted above, companies can go online in many different ways. Properly done, going online can have direct benefits in efficiency and sales opportunities in carrying on the traditional line of business. However, it may also create other opportunities that arise from the management of the information collected through the use of the Web site.

Information can move from being a supporting factor to being an independent source of value, adding a new element to the value chain.[34] Creating a customer database that can be mined to synthesize data can potentially generate revenues through targeted advertising special promotional offers, targeted products, and opportunities for alliances with other online businesses (which, for example, could become additional outlets). Any highly visited Web site also has the potential to serve as a "portal"[35] (or at least mini-portal) for the products and services of others, which can provide economies both of scale and scope—and information assets that can be re-used with virtually no incremental cost.

Make New Friends in the Virtual World

Right now, it appears that the only companies making profits from electronic commerce are vendors of electronic commerce products and services and their intermediaries. It is important, however, not to overlook the fact that the absence of current profits may be caused, in some cases, by pursuit of a strategic plan that requires large up-front investments to assure the growth that will create the traffic that will be the basis of a profitable future. Some sophisticated online businesses may be foregoing short-term profits for future market share.

Consulting firms large and small, software producers, equipment manufacturers, systems integrators, Web site designers, and others have proliferated in astonishing numbers—and the demand for them seems yet to be rising—which provides more opportunities for an array of intermediaries: financial institutions (to process transactions), "certification" authorities (to issue digital certificates to assure the identity of customers and/or business partners), "trusted intermediaries" (to help match supply and demand; e.g., portals and search engines), privacy assurance organizations (to assure customers of security and non-misuse of information), "good business practices" certifications (in the form of "seals" given to Web merchants who live up to a code of good business practices), and any number of "allies" with whom your Web site may have some kind of reciprocal relationship.

Electronic commerce over the Internet will typically involve relationships with an entirely new group of third-party companies and organizations that are only now coming into existence.

Protecting the Virtual Brand

Brands will continue to be important in virtual space, but may be used in new ways and new places. An easily identified brand, coupled with an appropriate Web address, may be a company's greatest asset online. With all of the portals, Web malls, Web hosting sites, Web communities, and so forth, the tendency over time will be for most products and services to take on some characteristics of a commodity, creating a situation in which a known and trusted brand becomes central. Although there's no guarantee that an existing strong brand can successfully make the leap into cyberspace, it's important for that brand to have a virtual presence.

Supporting a brand while working out exactly who's being targeted, and in what configuration, can be a challenge. But once you've got a consumer feeling comfortable with your site, it is possible to branch out and offer a range of products, some of them not traditionally associated with the brand. If the brand is not strong enough to support an independent Web site, then it will risk being diluted in or swamped by a sea of competitors, all striving to establish unique identities.[36]

Retail Models

Software bugs, baffling interfaces, and limited selections in today's typical online shop make even the corner grocery look like a miracle of organization and choice. For most consumers, today's Internet, far from being a perfect market, is "the high street from hell."[37] Electronic commerce companies addressing the consumer market also have to contend with the online absence of what analysts refer to as the social side of shopping. Many consumers enjoy making a shopping trip an event, and they want to handle merchandise, such as clothing, before buying it. Further, online orders from consumers are typically smaller, and buyers return to sites less frequently. These factors in large part explain why many major e-tailing companies aren't predicted to turn profitable until 2000 or later.[38]

As time goes by, perhaps the most radical occurrence will be the shift in the balance of power from merchant to consumer. That will be both a blessing and a burden. It means that online retailers and services must be far more responsive and competitive than their physical counterparts. With instant customer feedback, online merchants can further differentiate themselves from their physical-world competitors by customizing their shop or service for each customer.[39]

At present, no one knows with certainty what the successful model (or models) of Internet retailing will be. Some brands are so strong that they will likely prevail on their own. Other Web sites may, like the cable TV model (e.g., ESPN for sports, CNN for news, HBO for movies), become "category killers" for particular products or services (books, flowers, travel, financial services, etc.). Some sites will recreate shopping malls (seeing themselves not as an outlet, but as a conduit). Others will represent as many products and outlets as possible or create virtual communities (e.g., Geocities). Still others see their futures as portals, providing not just Internet access but destinations where visitors find free information and services, and intend to make their primary revenues from producing a high volume of traffic for advertisers and from transaction fees.

At present, all of these forms seem able to co-exist. The future is less clear for so-called "shopping agents" or "shopbots," bits of software that are supposed to scour the Web to locate—and perhaps negotiate for—the best deals for individual customers. So far, the results have been modest at best, and many merchants who are not interested in being the low-cost provider simply refuse them access. Shopbots will

likely, however, have some continuing role in searching for the best prices for commodities. But they will have to demonstrate that they can do so more accurately and efficiently than humans.

Another business model that is being tested, with limited success so far, is auctions. For example, eBay, an online auction site, currently offers over 1.5 million items in over a thousand categories for auction. While eBay functions like a traditional auction house, another site, the Trading Club, charges an annual membership fee for unlimited use. Yet another model is barter. The Trading Club reports it will soon open the "Swap Shop," where members can trade items for other items. Both models seem likely to survive in some form, as they serve particular needs.

One lesson from successful sites seems to be that turning customers into a virtual "community" can be very helpful. By participating in events, filling out forms, making suggestions, commenting on products, and so forth, customers can relate not only to the product or company, but to each other, building loyalty and desire to return through active engagement. In return, the Web site can offer its "community members" added value beyond the simple purchase of a product. These enhancements may, in part, compensate for the loss of the "shopping experience" of a visit to the mall and the experience of actually handling merchandise. Others companies have successfully used "associate" or "affiliate" programs to locate their "outlets" at as many sites as possible, paying a commission on each sale.[40]

Within the near future, consumers will find the online shopping experience fairly simple. They will register their contact and financial information with a single source (bank or intermediary) so that they do not have to fill out forms at different Web sites. They will have a "universal shopping cart" so that they can traverse Web sites seamlessly, and order products from different sites or catalogs with few or no time-consuming Web-site transitions. Companies and sites will offer e-mail reminder and "personal shopper" services. There will be guarantees of security (against loss from theft of information), privacy, and customer satisfaction. With one "click," all their purchases can be paid for, and the transaction and transfer of funds will take place in "real time."

At the same time, companies will use this integrated shopping cart technology and cross-catalog reporting for behavior profiling, market-basket analysis, and marketing automation. Software will then tailor advertising, product offers, and content based on individual consumer

preferences and history of purchases. User profiles and demographics will become the basis for targeted sales and related product recommendations.[41] This should enhance the value for the users.

With all these different possibilities, it becomes challenging to conceptualize this new virtual marketplace against some typical economic theory of a traditional market. There is, however, another kind of traditional market that may, in principle, bear some resemblance.

LESSONS FROM THE BAZAAR ECONOMY

In 1978, anthropologist Clifford Geertz, then with the Institute for Advanced Study, published a short paper in the *American Economic Review* titled, "The Bazaar Economy: Information and Search in Peasant Marketing," in which he described the thriving bazaar in the ancient walled town of Sefrou, at the foot of the Middle Atlas in Morocco.[42] While this might seem a strange analogy for a modern electronic technology, his observations bear further consideration vis-à-vis the Internet "bazaar":

> Considered as a variety of economic system, the bazaar shows a number of distinctive characteristics. Its distinction lies less in the processes which operate and more in the way those processes are shaped into a coherent form. The usual maxims apply here as elsewhere: sellers seek maximum profit, consumers maximum utility; price relates supply and demand; factor proportions reflect factor costs. However, the principles governing the organization of commercial life are less derivative from such truisms than one might imaging from reading standard economic textbooks, where the passage from axioms to actualities tends to be rather nonchalantly traversed. It is those principles—matters less of utility balances than of information flows—that give the bazaar its particular character and general interest.[43]

According to Geertz, the search for information one lacks, and the protection of information one has, is "the name of the game" in the bazaar. Capital, skill, and industriousness, along with luck and privilege, play as important a role in the bazaar as they do in any economic system. But they do so less by increasing efficiency or improving products than

by securing for their possessor an advantaged place in an enormously complicated, poorly articulated, and extremely noisy communication network.

The search for information—laborious, uncertain, complex, and irregular—is the central experience of life in the bazaar. The most persistent concerns are the price and quality of goods. Geertz identifies two key features: "clientelization" and bargaining. Clientelization is the tendency for repetitive purchasers of particular goods and services to establish continuing relationships with particular purveyors of them, rather than search widely through the market at each occasion of need. The bazaar's buyers and sellers, moving along the "grooved channels" laid down for them by clientelization, find their way again and again to each other. Clientelization reduces search to manageable proportions and "transforms a diffuse mob into a stable collection of familiar antagonists."[44]

A bazaar provides a high degree of spatial localization and "ethnic" specialization of trade, which simplifies the process of finding clients considerably. Once you have found a particular *bazaari* (shopkeeper) in whom you have faith and who has faith in you, you can count on that seller's continuing presence. Nor is the bazaari constantly faced with the necessity to seek out new clients. As Geertz notes, "Clientelization represents an actor-level attempt to counteract, and profit from, the system-level deficiencies of the bazaar as a communication network—its structural intricacy and irregularity, the absence of certain sorts of signaling systems and the undeveloped state of others, and the imprecision, scattering, and uneven distribution of knowledge concerning economic matters of fact."[45] Might this also describe the Internet?

Bargaining is multidimensional and intensive. In a system where little is packaged or regulated, and everything is approximative, the possibilities for bargaining along non-monetary dimensions are enormous. Search is primarily intensive because the sort of information one needs most cannot be acquired by asking a handful of index questions of a large number of people, but only by asking a large number of diagnostic questions of a handful of people. It is this kind of questioning, exploring nuances rather than canvassing populations, that bazaar bargaining represents.

Geertz notes that Sefrou bazaaris make a terminological distinction between bargaining to test the waters and bargaining to conclude an exchange, and they tend to conduct the two in different places: the first

with people with whom they have weak clientship ties, the second with people with whom they have firm ones. Extensive search tends to be desultory and to be considered an activity not worth large investments of time. For example, in the city of Rabat bazaar, bazaaris with shops located at the edge of the bazaar complain that such shops are "rich in bargaining but poor in selling," that is, people survey as they pass, but do their real bargaining elsewhere.

Whether or not the bazaar, which has developed its traditions over thousands of years, is an apt theoretical model or not remains to be seen, but its methods appear both instructive and suggestive as one thinks about the challenges ahead in e-commerce. The example of the bazaar in the context of the online community strongly indicates the importance of brands, and of maintaining a strong and direct relationship with the customer, not only by providing products and services, but by providing useful information. Those who fail to do so, like those on the fringes of the bazaar, may indeed find themselves "poor in selling."

Of course, no analogy is perfect, and cyberspace is not Sefrou—it is not bounded geographically and there are different resources for collecting and using information. But one thing is sure—cyberspace is not like conventional markets. The challenge for management, then, is at least as much psychological as technical and organizational. It includes dealing with global, as well as local and national rules, recognizing the implications for corporate structure, and developing and implementing an appropriate plan of attack.

MANAGEMENT CHALLENGES

Due to the apparent suddenness of electronic commerce's appearance, its high-tech aura, and its accompanying breathless publicity, the initial reaction of executives in many areas—including sales, marketing, and general management—may be to freeze or become defensive. But traditional tools of environmental scanning, thoughtful analysis and planning, and quick competitive response will continue to serve executives well. Remaining alert to external factors, approaching electronic commerce as an opportunity, and planning for the future are still the most likely keys to success.

External Factors—Learning The World's Rules

While it could easily fill another entire chapter, the subject of external factors affecting electronic commerce is not the primary focus of this chapter.[46] Suffice it to say that governments, acting through international organizations like the WTO, the OECD, and the United Nations, among others, are struggling to control, or at least manage, global electronic commerce.[47] There are still several key unsettled issues in the areas of privacy, security, taxation, and content control.

The United States has taken a strong position in favor of an international "hands off" policy with respect to electronic commerce. At this writing, that view is largely being adopted internationally, although not without criticism. Governments will continue to seek to maintain their sovereignty, protect their citizen/consumers, collect their taxes, and protect their cultures and traditions. The United States' position is that these are worthy objectives, but best achieved by the marketplace, industry self-regulation, and the use of "smart" hardware and software (e.g., to collect taxes, to filter undesirable content, etc.).

For businesses planning to do a significant amount of commerce online, it is extremely important to be aware of these developments on a continuing basis. It is also important to be familiar with regional and national rules should any significant portion of that business come from overseas. Questions of jurisdiction are among the most complex facing Internet regulation, but it is entirely possible that businesses will be subject to the rules of the place where *customers* are located, which may be very different than American rules. This applies to the general regulatory regime, as well as to commercial law, contract law, torts, and consumer protection.

Management Attitude is Key

In some respects, the implications of electronic commerce can be quite threatening to established managers who have matured in a "real"-world, "analog" business environment. Many of the lessons they have learned through hard experience are being brought into question, a situation which brings with it the ominous reappearance of "FUD" (fear, uncertainty, doubt),[48] a well-established factor in decision-making in the computer/information technology field. In light of this fact, perhaps the most significant threshold challenge is the overall mindset of management. There will likely be a few progressive managers who see e-commerce as a great opportunity; there will likely be a large number who will see it as a necessary response to meet

competition and change with the marketplace; and there will likely be some who see it as "this year's flavor"—another passing fad.

It is clear that, over time, doing business online, combined with internal IT, will create a new business model. At some point, quantitative changes in the amount and type of business done electronically will amount to a qualitative change that is an extension and expansion of the current concept of business process reengineering. The company's internal operations will become blended with those of its suppliers on one hand, and with its customers and other publics on the other.

At that point, it will become necessary to reconceptualize the nature and structure of the organization. Full integration of information technology and the Internet into the business processes implies a flatter, more distributed management structure, a reenvisioning of the channels of distribution, implementation of different kinds of customer management, and exploitation of new information elements in the virtual value chain. Online, the very idea of "location" becomes fluid, and "identity" may be shared with an array of strategic partners and trusted intermediaries. Since the Internet is inherently global, virtual consciousness must be far more globally aware than its "real" counterpart.

As a practical matter, the question managers must ask themselves is this: are the long-term costs higher for making the transition to e-commerce now, or for failing to do so? This question, of course, may be moot for any company that wants to serve as a vendor/supplier to the government, the Department of Defense, or an increasing number of major corporations that increasingly require it as a matter of course.

Approaching the Future: Plan, Don't Panic!

As corporate executives charged with planning and executive responsibilities look at the future, they should be asking themselves the following questions:

- Is electronic commerce more likely to be an opportunity or a cost for my company?
- What are the plans of my competitors?
- How can my company make an orderly entry into electronic commerce?
- Should it be in B2B, B2C, or both?

- What should be the process to develop a step-by-step plan, including resources, to implement it?
- Who should be in charge of this project?
- What resources are presently in place that can be applied to this undertaking?
- What additional resources do I need, and will I find them internally or externally?
- What will be the transition costs?
- Is the current management structure appropriate for electronic commerce?
- What will be the impacts on my current business relationships (especially distributors and agents)?
- How do I get "buy-ins" at every level for the plan?
- How do I explain these plans to all the stakeholders (including employees, investors, etc.)?

Entry into electronic commerce can be treated as a relatively trivial decision—simply a marginal extension of current operations—or as an opportunity to rethink how the company will carry out its mission and meet its competition in the next century. A determination of appropriate direction will have to come from the highest levels.

CONCLUSION

Electronic commerce, both business-to-business and business-to-consumer, is growing rapidly. It is being integrated into a vision of a seamless, reengineered global business structure built around information technology, and is supported by an international environment in which goods, services, and resources travel with few barriers. Over time, it will likely help flatten and reorganize business structures; create new relationships between companies, their vendors and customers; supplement, and in some cases, substitute for, established channels of distribution; create many new relationships with allies and "trusted third parties"; and "globalize" the nature of all businesses.

These developments will take place over time, and most companies not already facing online competition will be able to make the transition incrementally if they so choose. The challenge for managers will be to understand and adopt the new model and see how their enterprise fits into it. It will require a significant "letting go" of established structures and patterns, and a significant investment "on faith" to seriously enter into electronic commerce. However, it may be less costly to do it quickly than to wait.

One possible model for thinking about electronic commerce is a "global bazaar," less a perfect market than one in which the most valuable commodity is information, and patterns of relationships tend to become established and then not vary. In this connection, maintaining a strong brand, building a "community" of your customers, and finding strong allies all play a role in success.

As always, managers are faced with making choices with insufficient data. There is no known model. There is a lot of uncertainty. But managers are paid to take prudent risks with stockholders' money to produce long-term returns and increases in value. They should be asking themselves whether failing to move into electronic commerce would be living up to that duty.

ENDNOTES

1. The prediction of "$1 trillion in electronic commerce by 2002" was made by MIT professor Nicholas Negroponte at the September 1998 Electronic Commerce World Trade Show in Denver, and echoed in *The Wall Street Journal*'s 7 December 1998 special section titled *Selling Points*, whose article, "Click and Buy," by George Anders, looks toward a "$1 trillion economy online sometime in the next decade" (R4).

2. Mark Boslet and Joelle Tessler, "Online Commerce Moves Beyond Books—Business-to-Business Trade Proves Economical," *The Wall Street Journal*, 7 July 1998, obtained from the Dow Jones Interactive Publications Library.

3. Boslet and Tessler, "Online Commerce Moves Beyond Books."

4. "Census Bureau to Gather Online Commerce Statistics," *Telecommunications Reports Daily*, 5 February 1999. Secretary Daley further noted that the percentage of retailers with Web sites had grown to 39 percent from only 12 percent in 1997.

5. Mark Wallace and Ceri Jones, "E-Commerce: The Commercial Revolution," *Investors Chronicle*, 13 November 1998, 20.

6. Christopher Anderson, "Survey of Electronic Commerce. Doubling Games: Eventually, Bigger Means Different," *The Economist*, 10 May 1997.

7. Christopher Anderson, "Survey of Electronic Commerce. In Search of the Perfect Market," *The Economist*, 5 October 1997.

8. "New eCommerce Report Indicates: Online Retail Shopping Revenues to Increase to $35.3 Billion by 2002," *Business Wire*, 4 November 1998, announcing the *Retail Shopping Report* by eMarketer, an online business consulting firm.

9. Rebecca Quick, "Internet Retail Sales Rising Sharply: Internet Retailing May Drum Up $13 Billion in Revenue This Year," *The Wall Street Journal*, 18 November 1998, B6.

10. Quick, "Internet Retail Sales Rising Sharply."

11. "New eCommerce Report."

12. See Wallace and Jones, "E-Commerce: The Commercial Revolution."

13. Wallace and Jones, "E-Commerce: The Commercial Revolution."

14. Anderson, "In Search of the Perfect Market."

15. Anderson, "In Search of the Perfect Market."

16. Anderson, "In Search of the Perfect Market."

17. Anderson, "In Search of the Perfect Market."

18. See the following documents of the World Trade Organization (WTO): *Ministerial Declaration on Trade in Information Technology Products*, 13 December 1996; *Agreement on Basic Telecommunications Services*, 15 February 1997; *and The Agreement on Trade in Financial Services*, 12 December 1997. These documents can be retrieved from the WTO Web site at *http://www.wto.org/wto/ddf/ep/public.html*.

19. Robert Frieden, *International Telecommunications Handbook* (Boston: Artech House, 1996), 23.

20. See, for example, K. Ohmae, *The End of the Nation State* (London: The Free Press, 1995); and Dani Rodrik, *Has Globalization Gone Too Far*? (Washington, D.C.: Institute for International Economics, 1997).

21. "Smart cards" look like traditional credit cards, but have an embedded chip with information storage and processing capability. The cards can serve multiple purposes, e.g., advanced credit, debit, and stored value; medical records and authorizations; pre-paid telecommunications services; identification; government benefits; frequent flyer miles; etc. Their "stored value" can be changed (credited or

debited) electronically for online purchases or cash advances. About 100 million smart cards are estimated to be in use worldwide, with the number rapidly growing. A smart card group called the "Global Chipcard Alliance" and a Smart Card Industry Association are currently seeking to establish a global, interoperable "smart card" platform.

22. For background information on the history and development of the Internet, see the recent *Annual Reviews* of the Institute for Information Studies: *The Internet As Paradigm* (Queenstown, Md.: Institute for Information Studies, 1997) and *The Emerging Internet* (Queenstown, Md.: Institute for Information Studies, 1998).

23. U.S. Department of Commerce, "The Emerging Digital Economy Report," 15 April 1998, available online at *http://www.ecommerce.gov/letter.htm*.

24. U.S. Department of Commerce, "The Emerging Digital Economy Report."

25. See Nua, "Nua Analysis: Internet Users by Geographic Location" (dated 7 May 1998), available online at *http://www.nua.ie/surveys/analysis/graphs_charts/1995graphs/location.html*.

26. "Electronic Commerce Update," *Cyberspace Lawyer 3*, no. 1 (March 1998): 28, citing Activmedia.

27. TeleGeography 1999, "Geographic Distribution of Internet Hosts and Content" (Washington, D.C.: TeleGeography, Inc., October 1998), 113. While the United States' relative percentage of all hosts has been declining, the shift has largely been to other developed countries, with the OECD countries estimated to account for 96 percent of all hosts.

28. "China to Surpass Japan in Internet Users by 2005," *Business Wire*, 2 February 1999. Computer Economics can be located at *http://www.computereconomics.com*.

29. David Kirkpatrick and Cora Daniels, "The E-Ware War: SAP is Out to Rule the Market for Business Software. A Host of Smaller Companies Are in Its Way," *Fortune*, 7 December 1998, 102+.

30. Kirkpatrick and Daniels, "The E-Ware War."

31. George Anders, "Big Companies Fear Online Sales May Alienate Marketing Staff," *The Wall Street Journal*, 4 November 1998; obtained from Interactive Wall Street Journal, *http://interactive.wsj.com/articles/SB910069855946233500.htm*.

32. See Kirkpatrick and Daniels, "The E-Ware War."

33. Jim Rapoza, "Automating the Supply Chain," *PCWeek Online*, 23 November 1998.

34. Jeffrey Rayport and John Sviokla, "Exploiting the Virtual Value Chain," *Harvard Business Review*, November-December 1995, 75–85.

35. "Portals" are Web sites (often built around search engines) that provide access to a wide array of content and thus become in themselves a "destination" rather than

just a "gateway" to the Internet, and so can generate business by selling advertising and commissions on services based on a high level of traffic. See, for example, "Portals are Banking on New Search Features," *PCWeek Online*, available online at *http://www.sznet.com/pcweek/stories/printme/0,4235,372111,00.html*.

36. See Wallace and Jones, "E-Commerce: The Commercial Revolution."

37. Anderson, "In Search of the Perfect Market."

38. See Boslet and Tessler, "Online Commerce Moves Beyond Books."

39. Anderson, "Doubling Games."

40. See, for example, "IntelliSeek Launches Web Link Partner Program," *Business Wire*, 2 November 1998.

41. See, for example, "Retek Announces Creation of E-Commerce Vertical," *Business Wire*, 19 October 1998.

42. Clifford Geertz, "The Bazaar Economy: Information and Search in Peasant Marketing," *American Economic Review*, 68, no. 2 (May 1978), 28–32, reprinted in *The Economics of Communication and Information*, ed. by Donald Lamberton (Brookfield, Vt.: Edward Elgar Publishing Co., 1996), 78–82.

43. Geertz, "The Bazaar Economy," 79.

44. Geertz, "The Bazaar Economy," 80.

45. Geertz, "The Bazaar Economy," 81.

46. The reader interested in this subject should see Elliot Maxwell, "The Internet and Electronic Commerce: A Tale of Three Cities," in *The Emerging Internet*, 109–127.

47. See various documents available online at *http://www.ecommerce.gov*.

48. FUD, /fuhd/ n. Term coined by Gene Amdahl after he left IBM to found his own company: "FUD is the fear, uncertainty, and doubt that IBM sales people instill in the minds of potential customers who might be considering [Amdahl] products." See The Jargon Lexicon, available online at *http://www.huis.hiroshima-u.ac.jp/Computer/Jargon/LexiconEntries/FUD.html*, and dated 27 November 1998. The same phrase was subsequently used in reference to doing business with the company Microsoft. See, for example, James Turner, "Keeping Computing's FUD Factor at Bay," *Christian Science Monitor*, 19 November 1998, 15, from the Dow Jones Interactive Publication Library.

How Will Work Change? E-Lancers, Empowerment, and Guilds

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Many people today believe that business is changing in ways that are as significant as any in history.[1] In fact, terms such as "the networked economy," "the information revolution," and "electronic business" are already in danger of becoming almost meaningless clichés. But what will these changes really look like? What new ways of organizing work—and even new ways of thinking about work—will become common in the future?

Of course, no one knows for sure what the future will bring. But our research suggests one very plausible possibility: large, hierarchical corporations will recede in importance in the global economy and decentralized ways of organizing work will grow.[2]

The fundamental unit of such a possible economy isn't the corporation, it's the individual. Tasks aren't assigned and controlled through a stable chain of management; they're carried out autonomously by independent contractors. These electronically connected freelancers—we call them *e-lancers*—join together into fluid and temporary networks to produce and sell goods and services. When the job is done—after a day, a month, a year—the network dissolves, and its members

become independent agents again, circulating through the economy, seeking the next assignment.

This way of organizing work is already common in some industries. For example, this is the way many construction projects are organized; a general contractor assembles a temporary team of subcontractors—carpenters, electricians, plumbers, and others—to work together for a short time, each doing his or her part in creating a complex building. Book publishing is similar in many ways, too: there may be a stable publishing firm that coordinates the overall effort, but the production of a book usually includes a one-time combination of an author, an editor, illustrators, copy-editors, and so forth.

The question we pose in this chapter is this: what if this way of organizing work becomes common in many other industries? What if, for example, this is the way people begin to build cars? Or run banks? Or design computers?

Far from being a wild hypothesis, the e-lance economy is, in many ways, already upon us. It's there in the evolution of the Internet. It's there in the emergence of virtual companies, in the rise of outsourcing and telecommuting, and in the proliferation of freelance and temporary workers. Even within large organizations, it's there in the increasing importance of ad-hoc project teams, in the rise of "intrapreneurs," and in the formation of independent business units.

All these trends point to the devolution of large, permanent corporations into flexible, temporary networks of individuals. No one can yet say exactly how important or widespread this new form of business organization will become, but judging from current signs, it is not inconceivable that it could define work in the twenty-first century just as the industrial organization defined work in the twentieth. If it does, the very ways we think about business and society will be changed forever.

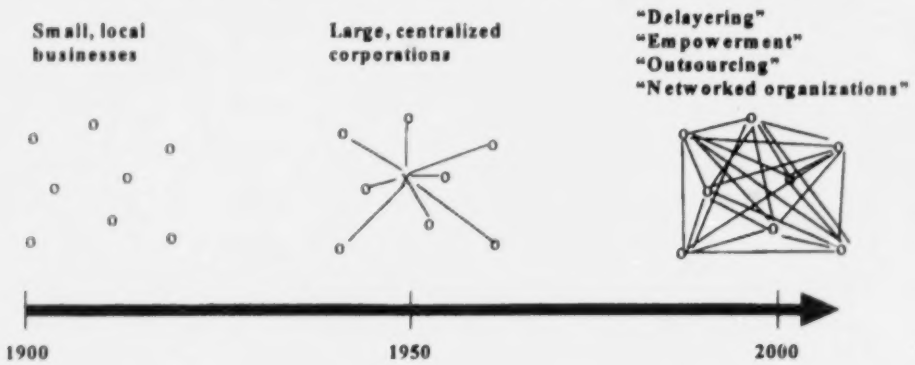
In the remainder of this chapter, we'll provide some glimpses of what this world may be like: why it may emerge, what it may look like, and how management may change. We'll also consider what can be done to make this world a more livable one for the hordes of potentially lonely e-lancers themselves. And finally, we'll suggest that what is needed most for this new world is not just new ideas, but new ways of thinking.

WHY MIGHT THIS HAPPEN?

To see why the changing nature of work may transform society, consider the historical evolution of business organizations in the United States in this century. Figure 1 shows three stages of this evolution: from small, local businesses to large, centralized corporations to "delayered," networked organizations. Until about a hundred years ago, most people worked near their homes, often by themselves, producing products or services for their neighbors. The business organizations that did exist—farms, shops, foundries—were usually small, consisting of a few owners and employees. When products reached distant consumers, they did so through a long series of transactions with various independent wholesalers, jobbers, shippers, storekeepers, and itinerant peddlers.

It was not until about the beginning of this century that the hierarchical, industrial corporation was born, subsuming a broad array of functions and, often, a broad array of businesses. One of the most extreme examples of this kind of organization was General Motors,

Figure 1: Simplified Summary of the History of Business Organizations in the Twentieth Century



which owned or controlled a huge portion of the chain of activities involved in producing automobiles—from South American plantations that produced rubber for tires to small-town dealerships that sold and serviced the cars. The rise of this form of organization was the most important story in the history of business in this century, and by the middle of this century the large, industrial organization had matured to become the dominant form of business throughout the developed world.

This type of business organization continues to dominate the world economy today. The world remains in the age of multinational mega-companies, and those companies appear to be rushing to meld into ever-larger forms. The headlines of the business press tell the story: Compaq buys Digital. WorldCom buys MCI. Citibank merges with Travelers. Daimler-Benz acquires Chrysler. British Airways allies with American Airlines (which in turn allies with US Airways). Some observers, projecting this wave of consolidation into the future, foresee a world in which giant global corporations replace nations as the organizing units of humanity, and citizens of Sony or Shell or Wal-Mart march out every day to do battle with the citizens of Philips or Exxon or Sears.

Such a scenario certainly seems plausible. Yet a look beneath the surface of all the merger-and-acquisition activity reveals signs of a counterphenomenon: the *disintegration* of the large corporation. People are leaving big companies and joining much smaller companies or going into business for themselves as contract workers, freelancers, or temps. Twenty-five years ago, one in five U.S. workers was employed by a Fortune 500 company. Today the ratio has dropped to less than one in ten.[3] The largest private employer in the United States is not General Motors or IBM or UPS. It's the temporary-employment agency Manpower Incorporated, which in 1997 employed 2 million people. While big companies control ever-larger flows of cash, they are exerting less and less direct control over actual business activity. They are, so to speak, growing hollow.

Even within large corporations, traditional command-and-control management is becoming less common. Decisions are increasingly being pushed lower down in organizations. The word "empowerment" has already become a cliché for a new style of management in which workers are rewarded less for efficiently carrying out orders than for figuring out what needs to be done and then doing it. Some large industrial companies like Asea Brown Boveri and British Petroleum have broken themselves up into scores of independent units that transact business with one another almost as if they were separate companies. And in some industries such as investment banking and consulting, it is often easier to understand existing organizations not as traditional hierarchies but as confederations of entrepreneurs united only by a common brand name.

What underlies this trend? Why did large, centralized organizations become so prevalent in the first place? Why is the traditional industrial organization now showing evidence of disintegration? Why are virtual organizations, empowerment, and e-lancers coming to prominence now? And are these trends likely to continue or are they just aberrations at the end of the twentieth century?

Our research suggests that a simple pattern underlies this whole sequence of changes and that the trend is likely to continue unabated well into the next century. The basic logic of this progression from small, local businesses through large, centralized corporations to delayered, networked organizations derives from two simple assumptions:

- Each stage in this progression requires more communication than the previous one, but—at least in some situations—has advantages over the previous stage; and,
- New information technologies significantly reduce the costs of communication.

The interrelation of these two factors means that as communication costs decrease, there eventually comes a point for each business structure at which its advantages over the type of business that thrived at a previous stage will more than offset (in some situations) the (diminishing) disadvantage of its increased communication costs.

Until about the beginning of this century, goods and messages were transported primarily by foot, by horse, or by boat, a process that was slow, unreliable, and often dangerous. Because there was no efficient way to coordinate disparate activities, most people worked alone or in very small, local groups. They made their own decisions based primarily on the information available in their local environments. And their farms, shops, and small craft works were the dominant form of business organization throughout most of human history. In some parts of the world, this business model continues to prevail.

However, in other societies, as new transportation and communication technologies (such as trains, cars, telephones, radios, and computers) lowered the costs of communication, the efficient, *centralized* control of much larger and more dispersed groups of people became economically feasible. But just because it was economically *feasible* to do this, was it

also economically *desirable*? In many cases, the answer was yes. The centralized managers at the tops of these new corporations could integrate diverse kinds of information from far-flung parts of the world and take advantage of greater economies of scale. In this way, they could often make much better decisions and run much more profitable companies than the independent, local decision-makers they superseded.[4]

But as communication costs fall even further, a point occurs at which it is economically feasible not just to bring all relevant information to a single *central* point for decision-making, but to make all relevant information available at *all* points in the organization. For the first time in human history, it is now feasible for vast numbers of people to have access to just as much good information as was previously available only to the most well-informed central decision-makers of the past.

And so a new question occurs: does the fact that vastly more people *can* be well-enough informed to make good decisions imply any economic benefit in letting them do so? Again, in many cases, the answer is yes. Making decisions closer to the point at which they are actually carried out (e.g., "closer to the customer") can have many economic advantages. For instance, in many kinds of work, people are more energetic and creative if they have more choices and a greater feeling of being in control of their own work. And "local" decision-makers also often have access to information that is critical to making good decisions but hard to communicate to central decision-makers. For example, the look in a customer's eye when you announce a new price may be crucial information for future pricing decisions, but it may also be very hard to communicate to a marketing manager at corporate headquarters.

Of course, factors like motivation, creativity, and local decisions are not important in all situations. In some cases, the simple economies of size and scale that drove the rise of centralized corporations in this century will continue to be the most important economic factors in the next. But in more and more parts of our knowledge-based economy, size is becoming an irrelevant advantage or even a handicap. Increasingly, the most important economic advantages come not from size and scale, but from speed, innovation, and creativity. In these parts of the economy, we believe, the relentless decreases in communication costs will enable more and more decisions to be decentralized to smaller and smaller units. In many cases, they will be decentralized to the lowest possible level: networks of independent e-lancers.

In one sense, the new coordination technologies enable society to return to the preindustrial organizational model of tiny, autonomous businesses—businesses of one or of a few—conducting transactions with one another in a market. But there's one crucial difference: electronic networks enable these microbusinesses to tap into global reservoirs of information, expertise, and financing that once were available only to large companies. Thus, small companies enjoy many of the benefits of the big without sacrificing their own characteristic leanness, flexibility, and creativity.

In the future, as communications technologies advance and networks become more efficient, the shift to e-lancers promises to accelerate. Should that shift indeed take place, the dominant business organization of the future may not be a stable, permanent corporation but an elastic network that may sometimes exist for no more than a day or two. When a project needs to be undertaken, requests for proposals will be transmitted or electronic want ads posted; individuals or small teams will respond; a network will be formed; and new workers will be brought on as their particular skills are needed. Once the project is done, the network will disband.

HOW WILL E-LANCE NETWORKS LOOK?

From the 1920s through the 1940s, the movie business was controlled by big studios like MGM and Columbia. The studios employed actors, directors, screenwriters, photographers, publicists, even projectionists—all the people needed to produce a movie, get it into theaters, and fill the seats. Central managers determined which films to make and who would work on them. The film industry was a model of big-company, industrial organization.

By the 1950s, however, the studio system had disintegrated. Power had shifted from the studio to the individual. Actors, directors, and screenwriters had become freelancers, and now made their own choices about what projects to work on. For a movie to be made, these freelancers would join together into a temporary company, which would employ different specialists as needed from day to day. As soon as the film was completed, the temporary company would go out of existence,

but the various players would, in time, join together in new combinations to work on new projects.

The shift in the film business from permanent companies to temporary affiliations shows how entire industries can evolve, quite rapidly, from centralized structures to network structures. And such transformations are by no means limited to the idiosyncratic world of Hollywood. Many manufacturers today are pursuing radical outsourcing strategies, letting external agents perform more of their traditional activities. The U.S. computer-display division of the Finnish company Nokia, for example, chose to enter the U.S. display market with only five employees. Technical support, logistics, sales, and marketing were all subcontracted to specialists around the country. The fashion accessories company Topsy Tail, which has revenues of $80 million but only three employees, never touches its products through the entire supply chain. It contracts with various injection-molding companies to manufacture its goods; uses design agencies to create its packaging; and distributes and sells its products through a network of independent fulfillment houses, distributors, and sales reps. Nokia's and Topsy Tail's highly decentralized operations bear more resemblance to the network model of organization than to the traditional industrial model.

Another, broader example, is the textile industry in the Prato region of Italy. In the early 1970s, Massimo Menichetti inherited his family's business, a failing textile mill. Menichetti quickly broke up the firm into eight separate companies. He sold a major portion of equity—between one-third and one-half—to key employees, and he required that at least 50 percent of the new companies' sales come from customers that had not been served by the old company. Within three years, the eight new businesses had achieved a complete turnaround, attaining significant increases in machine utilization and productivity.

Following the Menichetti model, many other big mills in Prato broke themselves up into much smaller pieces. By 1990, more than 15,000 small textile firms, averaging fewer than five employees, were active in the region. The tiny firms built state-of-the-art factories and warehouses, and they developed cooperative ventures in such areas as purchasing, logistics, and R&D, where scale economies could be exploited. Textile production in the area tripled during this time, despite the fact that the textile industry was in decline throughout the rest of

Europe. And the quality of the products produced in the Prato region rose as innovation flourished. Textiles from Prato have now become the preferred material for fashion designers around the world.

Playing a key role in the Prato textile industry are brokers, known as *impannatori*, who act as conduits between the small manufacturing concerns and the textile buyers. The *impannatori* help coordinate the design and manufacturing process by bringing together appropriate groups of businesses to meet the particular needs of a customer. They have even created an electronic market that serves as a clearinghouse for information about projected factory utilization and upcoming requirements, allowing textile production capacity to be traded like a commodity.

The Prato experience shows that a flourishing economy can be built on the network model, but Prato, it could be argued, is a small and homogenous region. How would a complex, diverse industry operate under the network model? The answer is: far more easily than one might expect. As a thought experiment, let's take a journey forward in time, into the midst of the twenty-first century, and see how automobiles—the archetypal industrial product—are being designed.

General Motors, it turns out, has split into several dozen separate divisions that have outsourced most of their traditional activities. They are now small companies concerned mainly with managing their brands and funding the development of new types and models of cars. A number of independent manufacturers perform fabrication and assembly on a contract basis for anyone who wants to pay for it. Vehicles are devised by freelance engineers and designers who join together into small, ever-shifting coalitions to work on particular projects. A coalition may, for example, focus on engineering an electrical system or on designing a chassis, or it may concentrate on managing the integration of all of the subsystems into complete automobiles.

These design coalitions take many forms. Some are organized as joint ventures; some share equity among their members; some are built around electronic markets that set prices and wages. All are autonomous and self-organizing, and all depend on a universal, high-speed computer network—the descendant of the Internet—to connect them to one another and exchange electronic cash. A highly developed venture-capital infrastructure monitors and assesses the various teams and provides financing to those that seem most promising.

Not only has this market-based structure been proven to be highly efficient, with little managerial or administrative overhead, it has spurred innovation throughout the automotive industry. While much of the available venture capital goes to support traditional design concepts, some is allocated to more speculative, even wild-eyed, ideas, which—if successful—could create enormous financial rewards. A small coalition of engineers may, for example, receive funds to design a factory for making individualized lighting systems for car grilles. If their idea pans out, they could all become multimillionaires overnight. And the next day, they might dissolve their coalition and head off to seek new colleagues and new challenges.

Over the past few years, under the auspices of the Massachusetts Institute of Technology's initiative on Inventing the Organizations of the 21st Century, the authors of this chapter have worked with a group of business professors and executives to consider the different ways business might be organized in the next century.[5] The automotive design scenario we've just laid out, which was discussed and refined by this group, was subsequently shared with managers and engineers from big car companies. They not only agreed that it was a plausible model for car design but also pointed out that the auto industry was in some ways already moving toward such a model. Many auto makers have been outsourcing more and more of their basic design work, granting ever-greater autonomy to external design agencies.

A shift to an e-lance economy would bring about fundamental changes in nearly every business function, not just in product design. Supply chains would become ad-hoc structures, assembled to fit the needs of a particular project and disassembled when the project ended. Manufacturing capacity would be bought and sold in an open market, and independent, specialized manufacturing concerns would undertake small batch orders for a variety of brokers, design shops, and even consumers. Marketing would be performed in some cases by brokers, and in other cases by small companies that would own brands and certify the quality of the merchandise sold under them. In still other cases, the ability of consumers to share product information on the Internet would render marketing obsolete; consumers would simply "swarm" around the best offerings. Financing would come less from retained earnings and big equity markets and more from venture capitalists and interest-

ed individuals. Small investors might trade shares in ad-hoc, project-based enterprises over the Internet.

Business would be transformed fundamentally. But nowhere would the changes be as great as in the function of management itself.

HOW WILL MANAGEMENT CHANGE?

In the mid-1990s, when the Internet was just entering the consciousness of most business executives, the press was filled with disaster stories. The Internet, the pundits proclaimed, was about to fall into disarray. Traffic on the World Wide Web was growing too fast. There were too many Web sites, too many people online. Demand was outstripping capacity, and it was only a matter of months before the entire network would crash or freeze.

It never happened. Indeed, the Internet has continued to expand at an astonishing rate. Its capacity has doubled every year since 1988, and today more than 90 million people are connected to it. They use it to order books and flowers, to check on weather conditions in distant cities, to trade stocks and commodities, to send messages and spread propaganda, and to join discussion groups on everything from soap operas to particle physics.

So who's responsible for this great and unprecedented achievement? Who oversaw what is arguably the most important business development of the last fifty years? No one. No one controls the Internet. No one's in charge. No one's the leader. The Internet grew out of the combined efforts of all its users, with no central management. In fact, when we ask people in the know whether they think the Internet could have grown this fast for this long if it had been managed by a single company—AT&T, for example—most say no. Managing such a massive and unpredictable explosion of capacity and creativity would have been beyond the skills of even the most astute and capable executives. The Internet *had* to be self-managed.

The Internet is the greatest model of a network organization that has yet emerged, and it reveals a startling truth: in an e-lance economy, the role of the traditional business manager changes dramatically and sometimes disappears completely. The work of the temporary company

is coordinated by the individuals who compose it, with little or no centralized direction or control. Brokers, venture capitalists, and general contractors all play key roles—initiating projects, allocating resources, and coordinating work—but there need not be any single point of oversight. Instead, the overall results *emerge* from the individual actions and interactions of all the different players in the system.

Of course, this kind of coordination occurs all the time in a free market, where products ranging from cars to copying machines to soft drinks all get produced and consumed without any centralized authority deciding how many or what kinds of these products to make. More than two hundred years ago, Adam Smith called this kind of decentralized coordination the "invisible hand" of the market, and we usually take for granted that it is the most effective way for companies to interact with one another.

But what if this kind of decentralized coordination were used to organize all the different kinds of activities that today go on *inside* companies? One of the factors that allows a free market to work is the establishment and acceptance of a set of standards—the "rules of the game"—that govern all transactions. The rules of the game can take many forms, including contracts, systems of ownership, and procedures for dispute resolution. Similarly, for an e-lance economy to work, whole new classes of agreements, specifications, and common architectures will need to evolve.

We see this already in the Internet, which works because everyone involved with it conforms to certain technical specifications. You don't have to ask anyone for permission to become a network provider or a service provider or a user; you just have to obey the communication protocols that govern the Internet. Standards are the glue that holds the Internet together, and they will be the glue that binds temporary companies together and helps them operate efficiently.

To return to our auto industry scenario, car designers would be able to work independently because they would have online access to highly detailed engineering protocols. These standards would ensure that individual component designs are compatible with the overall design of the vehicle. Headlight designers, for example, would know the exact nature of any connections that need to be made with the electrical and control systems.

Standards don't have to take the form of technical specifications. They may take the form of routinized processes, such as we see today in the medical community. When doctors, nurses, and technicians gather to perform emergency surgery, they usually know what process to follow, what role each will play, and how they'll interact with one another. Even if they've never worked together before, they can collaborate effectively without delay. In other cases, the standards may simply be patterns of behavior that come to be accepted as norms—what might today be referred to as the culture of a company or "the way things are done" in an industry.

One of the primary roles for the large organizations that remain in the future may be to establish rules, standards, and cultures for network organizations operating partly within and partly outside their own boundaries. Some global consulting firms already operate in more or less this way. For example, the management consulting firm McKinsey & Company has established a strong organizational culture with well-understood norms for how people are selected and promoted and how they are expected to work with others in the company. But the top managers do not tell individual partners what kind of work to do, what clients to work for, or what people to select for their consulting teams. Instead, the partners make largely autonomous decisions about what they will do and how they will do it. In other words, the value the firm provides to its members comes mainly from the standards—the rules of the game—it has established, not from the strategic or operational skills of its top managers.

As more large companies establish decentralized, market-based organizational structures, boundaries between companies will become much less important. Transactions within organizations will become indistinguishable from transactions between organizations, and business processes, once proprietary, will freely cross organizational boundaries. The key role for individuals—whether they call themselves managers or not—will be to play their parts in shaping a network that neither they nor anyone else controls.

WHAT ABOUT THE PEOPLE?

In many situations, these new ways of working may have real advantages for economic efficiency and flexibility. But what about the individuals in these highly productive, flexible networks? Where will they go to satisfy the human needs that are satisfied today by large organizations? How, for instance, will they find financial security? Who will provide for their health care and retirement? Will they be lonely, working all day with only their customers and suppliers, but never with colleagues?

It is common, in the Industrial-Age mind-set, to assume that meeting these needs is the responsibility of the employer, the government, or the individuals themselves. But as we thought about these questions, we realized that there was another obvious—if not yet widely appreciated—possibility.

What if there were a new kind of organization whose purpose was not to produce any specific product, but instead, to meet the human needs of its members that were not met in any other way? What if, rather than relying on an employer or on the government to fill these needs, individual workers joined independent organizations whose primary purpose was to provide stable "homes" as the workers moved from job to job? We will call these organizations "guilds" by analogy to the craft associations of the Middle Ages.

It shouldn't be surprising to find harbingers of these kinds of organizations in industries that already use a large number of freelancers, and one interesting example exists today in the movie industry. The Screen Actors Guild in Hollywood is even called a "guild," and it already performs some of the functions the we think other guilds will need to perform in the future. For example, as much as 30 percent of its members' base pay goes to the Guild benefits fund, in return for which members get full health benefits, generous pensions, and numerous professional development programs.

Imagine an extended version of this arrangement wherein members paid a fraction of their income to the guild in the good times in return for a guaranteed minimum income in the bad times. Of course, this is a form of unemployment insurance. But unlike the case of conventional unemployment insurance, your fellow guild members would have an incentive to help you find work, to help you gain the skills needed to be productive, and to exert social pressure on you if they felt you weren't trying.

For example, guilds could organize formal training programs and sponsor apprenticeship programs, where more experienced professionals might play a mentoring role for younger workers. In addition, guilds could create opportunities for socializing between workers active in the same industry or functional area. Another role guilds could play in helping members find work would be in establishing and verifying their members' reputations. One approach might be to create standards outlining various skill levels and recommended pay bands for each. Another could involve collecting evaluations, in an agreed-upon format, based on a worker's performance on prior projects. A system of this sort would provide the same sort of ongoing record that currently exists in an employee's personnel file at a traditional firm, even though the guild member's work might have been undertaken with a number of different companies.

Finally, guilds could provide a meeting place, either actual or virtual, where workers with similar interests and experiences might gather on a regular basis to trade stories and share advice. In this way, guilds could help recreate for future workers the daily socializing that today occurs around the office coffee machine, the factory lunch truck, or during chance encounters in the corporate hallway.

Where will these guilds come from? A number of organizations already exist today from which guilds like these could grow: professional societies, unions, college alumni associations, temporary help agencies, religions, neighborhoods, regions, and even extended families.

The Screen Actors Guild, to continue the example, is essentially a labor union; we expect that professional societies will increasingly provide similar kinds of benefits for their members. Another likely possibility is for guilds to emerge from groups of workers who have shared a common educational or work experience—university alumni associations or "alumni" groups comprised of veterans of the same firm. For instance, university alumni associations have long provided placement and professional networking services, and some now offer their members access to life insurance, health insurance, low-interest credit cards, and investment advising. It is not difficult to imagine alumni associations extending their activities further into such realms as continuing professional education, and possibly unemployment insurance for their alumni who have become e-lancers.

We think it is also likely that there will be increasing opportunities for profit-making organizations to fill some of these roles. For instance, some temporary help agencies are providing increasing benefits and services to the people they place and some copy shops are becoming gathering places for the numerous home-based workers in their neighborhoods.[6]

HOW CAN WE THINK ABOUT THIS?

Most of what we've said here is, of course, speculative. Some of it may happen; some of it may not. Big companies may split apart, or they may stay together but adopt much more decentralized structures. The future of business may turn out to be far less revolutionary than we've sketched out, or it may turn out to be far more revolutionary than we imagine. We're convinced, though, of one thing: an e-lance economy, though a radical concept, is by no means an impossible or even implausible concept. Most of the necessary building blocks—high-bandwidth networks, data interchange standards, groupware, electronic currency, venture capital micromarkets—are either already in place or under development.

What is lagging behind technology is our imagination. Most people are not able to conceive of a completely new economy where much of what they know about doing business no longer applies. Mitch Resnick, a colleague of ours at MIT, says that most people are locked into a "centralized mind-set."[7] Most people who look up into the sky and see a flock of birds flying in formation assume that the bird in front is the leader and that the leader is somehow determining the organization of all the other birds. In fact, biologists say, each bird is simply following a simple set of rules—behavioral standards—that result in the emergence of an organization.[8] The bird in the front is no more important than the bird in the back or the bird in the middle. They're all equally essential to the pattern that they're forming.

To meet the challenges of the future, people must recognize and question the biases of existing mind-sets. An e-lance economy may well lead to a flowering of individual wealth, freedom, and creativity, but it may also lead to disruption and dislocation. Free-agent workers, separated from the communities and safety nets of today, may find

themselves lonely, alienated, and increasingly separated into haves and have-nots. To seize the opportunities of this possible Golden Age of business—and to avoid its potential problems—will take as much creativity and wisdom as we can possibly muster.

ENDNOTES

Portions of this article were adapted from two previous publications: Thomas W. Malone and Robert J. Laubacher, "The Dawn of the E-Lance Economy," *Harvard Business Review*, 76, no. 5 (September–October 1998), 144–152; and Thomas W. Malone, "Is 'Empowerment' Just a Fad? Control, Decision-Making, and Information Technology," *Sloan Management Review*, Winter 1997, 23.

1. When one of us (Thomas Malone) speaks to business audiences about the changing nature of work, he often asks them whether they believe that the changes we are now undergoing are as big as those in the Industrial Revolution. As few as five years ago, when he first started asking this question, most audiences were about evenly divided in their answers. But for the last two or three years, almost all audiences have been almost unanimous in agreement. Another prominent theorist who holds the same view is Peter Drucker. See his "The Age of Social Transformation," *Atlantic Monthly*, November 1994.

2. For more about the influence of information technology on business organizations, see Malone, "Is 'Empowerment' Just a Fad?"; Thomas W. Malone, JoAnne Yates, and Robert I. Benjamin, "Electronic Markets and Electronic Hierarchies," *Communications of the ACM*, June 1987, 484; and Thomas W. Malone and John F. Rockart, "Computers, Networks, and the Corporation," *Scientific American*, September 1991, 128.

3. For a discussion of Fortune 500 employment, see Michael Useem, "Corporate Education and Training," in *The American Corporation Today*, ed. Carl Kaysen (New York: Oxford University Press, 1996), 292–326.

4. See, for example, A. D. Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass: Belknap Press, 1977).

5. See Robert J. Laubacher, Thomas W. Malone, and the MIT Scenario Working Group, "Two Scenarios for 21st Century Organizations: Shifting Networks of Small Firms or All-Encompassing 'Virtual Countries'?" *MIT Initiative on Inventing the Organizations of the 21st Century Working Paper No. 001* (Cambridge, Mass.: January 1997), available online at *http://ccs.mit.edu/21c/21CWP001.html*.

6. Laurie J. Flynn, "For the Officeless, A Place to Call Home; Not Just a Copy Shop Any Longer, Kinko's Pushes Its Computer Services," *New York Times*, 6 July 1998, D1.

7. Mitchel Resnick, *Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds* (Cambridge: MIT Press, 1997).

8. Resnick, *Turtles, Termites, and Traffic Jams*.

GLOBAL NETWORKS TOWARD NEW COMMUNITIES

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PAULINA AND THE PEACE CORPS: A CAUTIONARY TALE

In *Blood of the Condor*, a landmark film of 1960s Latin American cinema,[1] Paulina, a village woman, passes a young American woman from the Peace Corps on a mountain path. Paulina is carrying twenty or so eggs to sell in the village market. The Peace Corps woman asks to buy some on the spot, and Paulina readily accedes. When the American hears the minimal price, she offers to buy them all. Paulina refuses, to the amazement of the American, who cannot fathom why Paulina would not be glad to unload all the eggs and just go home without having to bother with all those noisy people at the market.

For the American, selling is selling, an anonymous market transaction to be accomplished as quickly and painlessly as occasion permits. For Paulina, going to the market means selling, yes, but to a number of people she knows very well and who actually need what she is selling. What one person in a poor village needs twenty eggs all at once? The village market is also a place where Paulina meets relatives and friends, renews social ties, hears the latest news (glad or sad), cracks jokes, sees who is wearing what, and divines community trends: economic transaction and community are fused, and the latter is of equal worth.

The encounter within the film's narrative is even more heavily symbolically charged than this, but for present purposes even this one aspect nicely frames the problem. Those of us who talk about "community" often use the term without batting an eyelid, but what we mean by it varies considerably, even diametrically. As we will see below, some Internet commentators, too, find community pregnant only with economic significance.

Let's set out, then, by fully coming to terms with the immense confusion the term "community" carries with it in contemporary discussions, a confusion that makes it impossible instantly to export the word into a discussion of the Internet and still stay lucid.[2] Then we'll nail down some meanings, so that at least the present discussion doesn't become too ethereal. Then we'll look at some widely divergent instances of netizen activity to see whether there is any sense in which "community" is a term that can be applied to illuminate rather than obscure Internet processes.

INTRODUCTION: THE MADDENING FOG OF THE TERM "COMMUNITY"

Community. The word in practice is hopelessly slippery and may convey a huge array of flavors:

- the face-to-face (FtF) village "warm fuzzies" that we supposedly lost with the urban-industrial epoch;[3]
- a rhetorical invocation of solidarity in the face of threat;[4]
- the intimate bond between social identity and a particular place (e.g., Manhattan's Harlem and the Silk Stocking district of its Upper East Side);
- a network of multiply bonded social relationships over time, even over generations (e.g., Iowan farming villages);
- a frequent longing for politics on a smaller, local scale, where, in today's huge and anonymous nations, democracy can be felt to be "real" because immediate; and
- a call for reconstructing social closeness and density, associated with a variety of writers sometimes labeled "communitarians."

Despite the differences in these conceptualizations of community, there is a commonality in tone: all of them have an unmistakably positive ring, perhaps not quite so magnificently all-embracing as motherhood, but on the way there. (Only in my own juxtaposing of the examples of Harlem and the Silk Stocking district is there an uneasy tremor of implied conflict.) Community's public relations machine is not merely purring, it seems, but lapping up the lubricant. But does the term have to carry this relentlessly rosy connotation?

Who can recall the film or the novel *The Return of Martin Guerre* without at least a brief hiccup of anxiety at the prospect of living in a medieval village community—where there would always be people who from anger at some wrong, real or imagined, would stubbornly refuse to talk to or even look at each other for years on end? How does the rosy village scenario account for the male elders who so often successfully sealed the "community's" women and young people into silence?

What does it mean today to speak of "the Hispanic community" in the United States when its constituent elements are so sharply diverse and often so aware of what divides them by nationality and dialect and "race"? Further, in India, or in Lebanon, or in the school desegregation riots in New Orleans in 1964 and Boston in 1974, "communalist" community bonds have had deeply negative effects.[5] The very strength of community ties, arguably, is what brings about a terrifying inversion of the warm fuzzies.

Where, in short, are power and anger in "community," inside or outside its bounds? Why, except as honeyed buzzwords, should everyday democracy and community be considered kissing cousins? Why the compulsion to sweetness and nostalgia? Why is the term so wish-laden and prescriptive rather than plainly descriptive?

In sum, if community's definition *outside* cyberspace is so ragged and draughty a tent, what on earth are we talking about when we project it online?[6] Are we talking about enabling "community"—whatever it is—to flourish more strongly? Or do we find ourselves in the same position as Paulina, our Bolivian villager, as we find ourselves suddenly faced with the fact that on a different and now dominant definition and strategy, Internet "community" is all about fertilizing new cash flows, not the warmth of social interaction? Jesse Berst has recently noted how major Internet providers are spending very large sums of money indeed to determine what makes an "online community" tick. He asks:

> Why are they working so hard and spending so much? To lock you in. The idea is to be the first to assemble a critical mass of customers. Through the phenomenon of "network effects"—the more people who belong to a network, the more people want to belong . . . —they create a barrier to other companies.
>
> Once they've got you locked in—and most people are loathe to change once they've found an online home—then they can charge other companies for access to you. As America Online has done so successfully already.[7]

Berst lists as corporate strategies free Web pages, chat spaces, habitual navigation starting points, spatially based communities, the identification of common interests, and of course commerce. His point is substantially underscored by a *Business Week* bestseller, *Netgain: Expanding Markets Through Virtual Communities*, by John Hagel and Arthur Armstrong.[8] The book sports chapter and section headings such as "The Race Belongs to the Swift" and "Positioning to Win the Broader Game" and "Managing Organic Growth."

Internet "community" under this rubric is certainly not an exercise in nostalgia or any kind of warm fuzzy. It is simply a new means to a rather obvious if traditional end, where "community" is validated because astute people can make money from other people's desire for social connectivity.

The words *global* and *networks* in the title of this chapter and book have similar, though not such chronic, problems. Does "global" simply mean planetary, or does it, too, flash an extra dazzle of the positive, of the hypermodern? Is "globalization" a form of international cultural compression (like the "growing together" of the USSR's nationalities into a Soviet community, so blandly prognosticated by Leonid Brezhnev and his cohorts)? Is it Americanization? Is it the evanescence of the capacity of all but the most powerful nation-states to design their publics' destinies in the face of transnational corporate clout?

And are "networks" simply telecommunications infrastructure? If so, are their opportunities assumed to be open to all in blissful, jolly anarchy, or seen to be hogged, like most else, by the affluent? Is "network" a polite poetic synecdoche, meaning the privileged use of the infrastructure by that portion of the global and national public with the economic and cultural capital to be able to do so?[9]

In each case—*community, global*, and *network*—there is a strong tendency in everyday commentary on the Internet to iron out the presence of power, antagonism, and economic and social division. And there's an equally strong tendency to use the terms to project what would be desirable, rather than what is actual. Steven Jones, in a recent discussion of community and the Internet, puts the point with exemplary sharpness:

> The ability to create, maintain, control space (whatever we call it—virtual, nonplace, networld) links us to notions of power and necessarily to issues of authority, dominance, submission, rebellion, and cooptation. . . . Just because the spaces with which we are now concerned are electronic, there is not a guarantee that they are democratic, egalitarian, or accessible. . . . [10]

A TAXONOMY OF COMMUNITY

A workable *descriptive* taxonomy of "community," I propose, is as follows.[11] These seven descriptions are not mutually exclusive, but singly or together reflect the very considerable diversity of types of social relations that the generic term "community" may designate. Here I am simply trying to separate out the identifiable strands of meaning in the designation.

- *Textured communities*: groups of people closely involved with each others' lives over any period of years on a face-to-face basis.
- *Attenuated communities*: groups consisting of ongoing but peripheral relationships, for whatever reason; this is the second loosest of these descriptions, but not, as we will note below, weak or trivial.
- *Historically based communities*: groups whose connections last two or more generations.
- *Place-based communities*: groups whose interconnections share a location that is simultaneously symbolic and geographic,[12] one that in practice is often tagged to sites of historical memory.

- *Professional-forum communities*: groups whose interconnections are based upon sharing a socially recognized craft (e.g., cabinet-makers, physicists, nuns).
- *Communalist communities*: religious/linguistic/racist ideologues and thugs and their adherents.
- *Imagined communities*: large agglomerations of people, as in Benedict Anderson's notion of the nation as an "imagined community" (though ethnic groups could also figure in this description);[13] the loosest of the seven descriptions because the constant tendency of the word "community" to imply the positive means it glosses over multiple differences and social antagonisms.

One insistent note, perhaps otiose by now: none of these taxonomic descriptions excludes conflict or power within any groups. None presumes harmony, except perhaps the last one, and that only in the case of defense against other forces threatening it from outside.[14]

I have attacked those who slip prescriptive conceptualizations of community under the counter along with analytical ones. However, there is nothing wrong with prescription per se so long as it is clearly labeled as such. In this discussion, I wish to draw attention to British sociologist and—in this instance—social philosopher Charles Husband, who has argued for the importance of striving to foster "the multi-ethnic public sphere."[15] His prescriptive description will also serve, along with the taxonomy listed already, as a useful measuring rod for the reality of community on, or off, the Internet.

Briefly, Husband proposes that we recognize three orders of human rights: first-order rights (rights of freedom from persecution, slavery, etc.); second-order rights (rights to basic health care, etc.); and third-order rights (to peace, development, the environment). Among the third-order rights, there has been considerable international discussion on and off over the past two decades about the right to communicate, a potential which the Internet seems to offer in exceptional measure.

Husband argues, however, that any discussion of the right to communicate must be grounded in two realities. One is the prevalence of forms of ethnic inequality and racism in the great majority, if not all, of the world's nations. The other, which flows from the first, is the urgent need to communicate across those barriers *and be understood*—which imposes a duty on listeners to try to listen, to extend their horizons and imagination, to learn. Hence, Husband proposes a right that is utopian

in the same degree as Jürgen Habermas' concept of the ideal speech situation: the right to be understood.

Clearly, human society is not likely to get there any time soon. Perhaps never. But if we were to focus on a positive potential in the Internet as regards cleansing and strengthening a multi-ethnic public sphere, the gap—at the very least—between Internet promise and performance is easily perceived to be a yawning one. And while the notion of "public sphere" does not immediately convey "community," Husband's argument underscores the degree of overlap between the two terms. Communities of all kinds communicate, by definition, whether constructively or the reverse, and need to communicate about what divides them—which in turn leads to the need for places, now including cyberspace, in which to hash out their problems.

It may also be useful to bring into this discussion Robert Putnam's investigation of different historical patterns of civic engagement in Italy, as a clue to a number of the issues we have been reviewing here.[16] In those regions of Italy in which Putnam found civic engagement to have been strong, place, generational time, a functioning public sphere, and textured community seem to have been leading elements in the mix. Perhaps complementarily, however, Mark Granovetter's emphasis on the value of "weak ties" in social life in the process of making one's way in the world—as opposed to the emphasis on very close ties assumed in many discussions of "community"—helps to refine further our sense of what we expect from community in the age of the Internet.[17] Similarly, perhaps, Lee Komito's proposal of primitive, loosely structured "foraging communities" coming together in anarchic modes for ad-hoc purposes, as an analogue to Internet communities, helps to capture the dimension of attenuated communal interactivity typically obscured in discussions of community.[18]

In other words, often communities have umbra and penumbra simultaneously, richness of texture as well as attenuation, partial engagement as well as close engagement. They may have ongoing divisions that may even lead to the word "community" being used as a mark of division simultaneously signifying different segments (e.g., the Black community, the Hispanic community) while obscuring internal divisions within those segments (e.g., "the" Hispanic community, "the" Black community). But if, prescriptively, the term community is to have a strong and positive sense, Husband's stipulation of the right to

be understood within a multi-ethnic public sphere is a crucial one, on and off the Internet, for almost by definition in a more or less segregated society each ethnic group has weak ties with the others.

SOME EXAMPLES

Online groups, whether labeled communities or not, exist in such a proliferation of forms that it is exceedingly hazardous to draw generalizations about them. Reading accounts of online groups is often rather like reading traditional cinema history, where films you have never seen (and almost certainly won't) flash past summarized in a paragraph or even a sentence, their place in the scheme of things distinctly hazy. What I have set out to do below is to pick sharply different types of example, some local, some global, as a way of illuminating the limits and possibilities of community on the Internet. These examples are not meant to be comprehensive, or conclusive, but are used as challenges to refine our thinking.

As I say, not all of them are global, that is, international, in reach; but while it is an overstatement to claim that the Internet has dissolved national frontiers, it is nevertheless the case that the way the Internet works is not bounded by them. What can be deduced about the Internet's global operation may in principle be founded as well upon a very local example as upon a strictly international example. That division between global and local, not only because of the Internet, but especially because of international migration among professional-intellectual strata, probably has less purchase on Internet activities than in many other spheres of life.

Blacksburg, Virginia: A Research Opportunity Lost

Our first instance of Internet and community is selected more to provide a case of the tech-enthusiasm inadequacies of many current studies of the subject than to serve as an actual source of insight. Blacksburg is supposedly America's most wired town, with the largest Internet infrastructure and use of any city. Blacksburg wired has been taken as emblematic of Internet community, conceived in this instance as the enhancement of already existing local community through Internet options.[19] It is also the home of Virginia Tech.

This city ought to offer a highly informative case study. The recent book edited by Michael Cohill and Andrea Lee Kavanaugh unfortunately fails to pose some very pertinent questions.[20] The chapters review a series of highly practical considerations, from data traffic overload to security filters for local businesses, from the creation of a digital library and the continuing importance of the conventional library, to modem pools. So far so good. Yet apparently the two primary impacts of the Blacksburg Electronic Village, at least to the time of the book's writing, were e-mail access and access to information resources. What does this finding mean for Internet *community*?

It is very hard to answer from the evidence supplied in the book. E-mail usage was estimated at 60 percent of the city's inhabitants in 1995, five years after the town began to be wired, and Internet usage at over 40 percent.[21] But if we are not even informed as to how this usage was distributed between town and gown,[22] then percentages—as impressive as they are—still leave us bereft of insight into the relation between the town's cultural capital and its seemingly ready adoption of computer-mediated communication (CMC).[23] This is a vital variable, if any pointers are to be drawn from Blacksburg's experience towards more global potential for the Internet.

Furthermore, e-mail use is principally point-to-point and this type of Internet use mainly enhances information resources. No doubt life was enhanced in Blacksburg by these means. We do know that a very popular site was devoted to where best to get your car fixed.[24]

But in what sense was *community* generated by information resources in the sense already identified fifty years ago by sociologist Morris Janowitz, who found that interaction within cohorts of parents whose children attended the same school was the yeast of newly forming local ties?[25] Was civic engagement, in Robert Putnam's sense, intensified by sharing auto repair information? Clearly, one thing can lead to another, as in the case of Janowitz' schoolchildren and their parents, but the acquisition of highly discrete technical information, however handy, creates little by way of overflow energy. It can be done anonymously in a public library without any further consequences. The widely popular National Public Radio call-in auto surgery program *Car Talk* does not create a community, friendly and helpful as the dialogue is on the show.

What was the relation between Internet interactivity and community? Seniors were very active on the Internet, we are told, but we do not

know who they were. Were they perhaps mostly emeritus Virginia Tech professors and their spouses, with long-existing friendships with one another? They too have every right to community if they want it, but in what sense did the Internet oxygenate their links—if at all? The study does not tell us.

Thus, unfortunately, the study raises more questions than it answers, and exhibits many of the vices of a-sociological communication research. It describes observable surface communication patterns without connecting to the deeper and more abiding relationships that underlie them. It is sadly not atypical of the early wave of Internet studies, but for our purposes it is only tantalizing. We should know more from Blacksburg than we do. Rather than leaping to conclusions about the Internet and community, based on superficial analysis, perhaps a certain cautious agnosticism is the best policy.

MST3K: *National Connectivity Via CMC and FtF*

To switch to a different instance of community, one that interestingly addresses the relation between what we have called textured and attenuated communities—but, in this case, communities where neither place nor generational history have any role—let us look at the Internet-using fans of *Mystery Science Theater 3000*. *MST3K* (to the fans) is a very witty product of the SciFi Cable Channel. There are very many such fan groups on the Net, from *Star Trek* enthusiasts to those who were intrigued by *Twin Peaks*. Each episode of *MST3K* shows a schlock film screened for three characters, seemingly silhouetted in the front row of an empty cinema, who offer an ironic running commentary on the film's narrative.

Alison Macor, of the University of Texas, has studied some varied contributors to the two main Internet chat spaces devoted to *MST3K*.[26] These fans describe themselves as a *community*. What do they mean by this?

As well as engaging in continuous review of the show over the Internet, these fans organize national gatherings where it is possible to meet and engage in debate face to face. Some travel very long distances in order to attend, and those of Macor's respondents who had made the trip endorsed the value of the meetings. In this case, we find an interesting combination of FtF and CMC modes of community interaction,

with CMC acting as the initial location of oxygen.[27] One of Macor's respondents argued that FtF is still superior to CMC for the growth of this kind of community of interest.

What distinguishes them as a community, in their own view, is their appreciation of humor, of offbeat allusions, and, in general, of the intellectual demands of the show, for the dialogue is very fast, witty, and referential. Cynicism, mental agility, and—interestingly—some writerly ambitions, were recognized as *community* hallmarks.

Here, then, there is recognition of the pleasures of Internet *interaction*; and while there was no unanimity about the relative utility of FtF and CMC modes, it is clear that more is at stake overall interactively and communally than just the utility of swapping experiences of different car mechanics in Blacksburg. The interpersonal engagement in *MST3K* seems on a much deeper plane, perhaps partly akin to the professional-forum sense of community identified above. In this instance, it appears that a quizzical, contrarian perspective on mass-produced culture has found its home and sustenance on the Internet for people whose local or work relationships might not offer any such supportive interaction. Particularly for those living in what feels to them like a cultural wasteland inhabited by T. S. Eliot's "hollow men," these *MST3K* chat groups operate as something of a mental lifeline.

A Holocaust Survivors' Network

Let us now switch to a definitively global instance. This example raises the questions of place and of generational history, textured community, imagined community, power, conflict, and the global, in a very particular and intense configuration.

I am referring to an Internet chat group spanning the continents, but to which access is strictly controlled,[28] that enables survivors of the Nazi Holocaust and their children to dialogue with each other in order to research connections with lost relatives and friends, some now long dead, others living thousands of miles away and apart from each other in other settings, sometimes with different last names. In cyberspatial terms, it is somehow "in" Germany, in Ukraine, in Poland, in Austria, Hungary, Russia, Lithuania, and other countries where Jewish communities were decimated and even totally exterminated, that there is emerging slowly a piece-by-piece partial reconstruction of historical

community. This partial reconstruction is emerging not only in order to resume direct interaction between the living, but also to honor the place that a community's forebears are due among the living and in oncoming generations in the record of its shaping.

The deeply perceptive critic Walter Benjamin once wrote that "*even the dead*" will not be safe from the fascist enemy who wins.[29] The continual desecration of Jewish graves in many countries draws a ring around Benjamin's arctic prediction. This Internet interaction, however, represents an extraordinary collective clawing-back of this past, against all the odds, its recuperation from oblivion. It reclaims collective memory, with the most significance indeed for Jews worldwide—but for all of us, too, in a species that, as the ebbing century has shown in unprecedented ways, is always capable of genocide.

This instance of Internet community presents us with yet another facet of the technology's potential, one related to historical community, to the ultimate extremes of community repression, to collective self-reassertion, and even to communal reconstruction in some measure. The fact that access to this community is controlled (and not by financial subscription), also raises significant questions about different kinds of Internet communities. While it is true that such communities can more easily be deserted at will than others, not all of them, as this case and one of those in the next example demonstrate, are accessible at will regardless of financial resources.

The Uyghurs

This instance takes the question of global community, imagined community, place, history, power, conflict, and the Internet to a different point, namely one of communal self-assertion against an authoritarian regime. Troy Barber, of the University of Texas, has investigated the strengthening of international community via the Internet in the case of the Uyghurs, a Turkic-language-speaking people native to the vast Xinjiang Province in Western China, and in Kazakhstan and Kyrgyzstan.[30]

The Uyghurs historically constituted and dominated that region from the eighth to the twelfth centuries C.E., guaranteeing Silk Road trade and serving in many respects as a cultural template for China's subsequent Mongol rulers. Historians have identified the Uyghurs as con-

stituting a crucial exchange point for information about book and printing techniques between East Asia and Europe. Historically renowned for their religious cosmopolitanism, today they are mostly Muslim.

The Uyghurs have experienced much of the same mixture of extrusion and repression at the hands of successive Chinese governments as Tibetans, but have received far less international support, possibly because of current Western stereotypes of Buddhism and Islam. Within China, they are widely stereotyped as both lazy and dangerous.

Among Uyghurs, a movement for the creation of an independent new state of Eastern Turkestan has resurfaced, and the Internet has provided a means by which widely scattered expatriate nationalists can share information and review strategies. There are two main e-mailing sites used by Uyghurs. One as of the present time is open to all, Uyghurs or sympathizers, and is probably numerically dominated by non-Uyghurs. In the 1990s, the primary residence of most users appeared to be the United States and Japan. The other site is much smaller and closed to non-Uyghurs, aside from a handful of proven sympathizers, in an effort to evade Chinese government surveillance. Predictably, discussion varies in frankness between the two sites.

Barber notes that there are certain endemic political problems facing the Uyghur activists in these sites over and above the predictably fierce opposition of China's authorities, namely the strong Islamic faith of most ordinary Uyghurs and the contrasting relative disinterest in Islam on the part of the Internet activists, which consequently gives the activists much less immediate basis of appeal to the Islamic majority.

Here then is an instance of Internet usage across multiple frontiers in order to support a movement for the autonomy of an imagined community,[31] even if real independence seems implausible at the present time.[32] Writing, however, at the end of a decade in which the European map has altered so sharply, and in which the central African map seems prone to dissolution, this movement and the south Asian movements noted below seem nonetheless to be ones to watch. The Uyghurs' movement was not created by the Internet, and the Uyghur netizens' current priorities may render their leadership weaker than it might be, but nonetheless a forum now exists for airing the Uyghurs' multiple and longstanding grievances.

Is such a cyberplace, with its base in social class, also partly redolent of what above I have termed a professional-forum community? Is

it just at this moment in Internet history that the leadership of professional intellectuals is particularly accentuated because of their early-adopter status, or is this just another chapter in the old familiar story? Certainly the disjuncture between intellectuals and their more general public, in this case in the form of religious attitudes, is a historically familiar one.

I think we can see that a pattern is beginning to emerge, one in which a variety of the strands identified in our seven identifications of community are seen to be twisted together in differing ways and with various strengths in Internet use.

Sindhi and Punjabi Online Groups

A similar global Internet phenomenon can be seen in—and out of—south Asia, one such case being Sindh, currently one of the five provinces of Pakistan, with a population of twenty million. Here we will see Internet use in the service of promoting the autonomy of an imagined community, the reconstruction in memory of that community against its symbolic obliteration,[33] and its mixture with everyday textured community, all on a global scale.

Sindh is one of the most ancient centers of south Asian civilization, containing the remains of the five-thousand-year-old cities of Harappa and Mojendro-Dara. Just over fifty years ago, in 1947, it was an epicenter of the Partition organized by the British. The Hindu third of the Sindhi population was forced out to make space for new Muslim settlers from elsewhere in the subcontinent. Many of the displaced left the subcontinent altogether, and now, over two generations later, there are more than ten millions in the Sindhi diaspora, spread over north America, Africa, east and south-east Asia, and the Caribbean. Since the 1980s, this original diaspora has also become compounded with new, voluntary professional migrants—engineers, scientists, doctors—from Sindh to north America and other regions.

Sindhis in Pakistan, like the Uyghurs, have also increasingly felt excluded from power and pushed to the bottom of the pile.[34] History books in Pakistan make no reference to the original Hindu segment of Sindh, paying attention only to Muslim history in the subcontinent. In a weird reflex of this State denial of history, outside Pakistan the younger generation of the original Hindu diaspora has also quite often been left unaware by their parents' generation that Sindhis continue to exist in

Pakistan. All in all, silences and barriers to communication have abounded within this contested and therefore often *un*imagined community.

Nabeel Zuberi of the University of Auckland has been studying this and other south Asian global political Internet usage, and has noted how (like the Uyghurs) the Sindhi lists are dominated by academic and professional expatriates.[35] The Internet has been a means by which the full history of Sindh, both Hindu and Muslim, has been able to become reconstituted within the global Sindhi public. Various e-mail lists center on gossip, and on political, educational, cultural, and religious topics. Human rights issues, banned books, and dissident voices, are given space denied them in Pakistan.

Not every element of these exchanges is intensely serious. Gossip I have already noted, but interestingly, in a so-far unpublished paper Zuberi writes:

> [T]his discourse is a mixture of fragments of wire service news, reports from Pakistani newspapers, campaigns for the release of political prisoners, human rights reports, transcriptions of poetry, sermons, and political speeches, debate about home-country politics, anecdotes about life in the "host nation," recipes for food, where you can buy Sindhi food and other products, arguments about the secular and profane, debate about the role of women, and you'll also find matrimonials. This discourse is usually conducted in English combined with some English transliteration of Sindhi.

What is interesting here is the range of issues, approximating the variety of communications characterizing a traditional local community (food, matrimonials), but incorporating a global political forum as well. Above I queried the relevance of auto-repair information-swapping as an index of significant Internet community in Blacksburg; this example goes to the heart of why I did so. Here is density of texture *as well as* attenuation.

For Zuberi, an important question raised is the relationship between the netizens' actual location outside their original homelands, their nation (conceived as an "imagined community"), and the meaning of their nationalist, or sub-nationalist, identifications and actions. Other instances from south Asia mentioned by Zuberi include Punjabis, whose territory was split at Partition. A consequence of Internet avail-

ability has been easy cross-border communication and the provisional re-establishment of a public forum in which part of the harm done to Punjabi community by Partition may be assuaged. With Internet providers now rapidly increasing in the ethnically and religiously fragmented—and sometimes viciously communalist—subcontinent and its nation-states, the prospects are also increasing for the reinvigoration of community. In the battle against communalism, the Internet may be used in both directions. We will still have to see whether it will be used mostly for good or for ill.

Anonymity, Tabu, and Internet Community

The newness of the Internet as a vehicle for some kinds of community relationship consists in considerable measure in the opportunity it offers for anonymity—the latter hardly an option in densely textured, locally based community. Sandy Stone, among others, has written of the avatars created in some online groups' manufacture of visual electronic communities.[36] In a surprising number of cases, these appear to have offered males the opportunity to reinvent themselves as females in the avatars they constructed for themselves. This is anonymity as masking. Pure anonymity, which can be shed at will, represents a somewhat different case.

One example comes from the Couples-L listserv, studied by Richard Cutler of the University of Texas, which enables adults to speak frankly and constructively on sexual issues in their relationships.[37] Conversations generally take the form of sharing questions and problems. Occasionally someone will be upbraided forthrightly, but the convention is toward a degree of encouragement being included with any assertion of censure. From time to time, dyadic FtF meetings are also organized through the listserv, even leading to dating.

Another example is America Online's site on "Race relations in Black and White," one of a number of sites profiled in *The New York Times* by Michel Marriott that enable White and Black Americans to talk frankly to each other about "race."[38] Sometimes what is exchanged is quite harsh, but at a distance and with anonymity, it is possible to address issues that mostly don't get addressed in public discourse at this point in time.[39]

There is a sour irony, but also paradoxically some positive hope here, in my comparison of these two zones for anonymous community discourse. The vigor of Puritanism and racism in U.S. culture, both of which have poisoned the well to an alarming degree, seemingly means that today only CMC enables that communal dialogue, exploration, and mutual support in these areas of our life that the sugary notion of a whole village raising a child implies was once upon a time our natural heritage. In reality, villages have often been hotbeds of sexual repression and forcing grounds of ethnic rage. Nostalgia blinds, especially for an invented past. So if highly charged issues can only be handled with the tongs of anonymity, is that not still better, as a stage (one hopes) along the way to something more direct, than staying cooped up in our fearful and isolating boxes?

Personal Web Pages and the Longing for Community

Aviva Rosenstein, of the University of Texas, has studied one far end of this process, namely the creation of personal Web pages.[40] In the first stages of her study, Rosenstein has found that some people who create Web pages for themselves initially do so as a purely intrapersonal form of communication, typically after experiencing some personal trauma that completely enveloped them.

As such, it might appear at first blush that, however much we might sympathize with the desire to overcome trauma, the personal Web page is a rather narcissistic enterprise. What is fascinating in Rosenstein's study, however, is the transition in each of her cases from intrapersonal reflection and dialogue to a sense for interaction with both a known *and an unknown* community:

> By imagining themselves in mediated dialogue with their Web audience, whoever that audience was conceived to be, they could elaborate on their dialogue with themselves. This process enabled them to reestablish a sense of continuity in their lives and achieve some resolution of the trauma experienced when the course of their lives had been disrupted. At some times the audience was represented by existing acquaintances or family, while at other times it was visualized as some unknown member of the mass audience who could relate to or identify with the emotional experiences disclosed on the home page. Yet at all times, the home page

> was fundamentally implicated as a symbolic link to those real or imagined interactional partners.

In this instance, a powerful if initially subterranean, even denied, need for community within metropolitan culture is evidenced through Internet use. A rich and fascinating profile of Lois Weisberg, commissioner of cultural affairs for the city of Chicago, drawn by Malcolm Gladwell, suggests in many ways a need for connectedness, both emotional and pragmatic, that underscores Rosenstein's finding.[41] Gladwell's detail is too great to reproduce here, but he paints a picture of someone whose life has pivoted around creating connectedness *on many different and changing levels* in a culture that all too easily and effortlessly, deflects it from gelling at all. In Weisberg's case, the connective, community-provoking activity appears abundantly personal, FtF to the maximum, though certainly aided by the telephone.

The point, however, is that here is a need—or a whole complex of needs—for various types and levels of community that may also be enabled, even fostered by Internet usage. For Rosenstein's respondents, an unknown community, the weakest of weak ties, also had value.

CONCLUDING OBSERVATIONS

As I conclude this chapter, perhaps "questions" would be a more appropriate term than "observations." What the evidence I have brought into play indicates is that *community* is a metaphor covering a variety of facets of Internet use. It is not a settled single fact of Internet use, some kind of solid platform from which we can begin to understand the Internet.

The question of cultural capital, social class, and Internet community is also of considerable interest. Above I critiqued the current deployment of the term "network" for its tendency to confuse potentially available technical infrastructure with its actual users. But there is no question at this point in time but that groups using the Internet—a more exact phrasing than "Internet communities"—are overwhelmingly drawn from professional classes. Whether Internet usage will follow the pattern of traditional literacy, and will work its way down the social class and educational hierarchy over time, and if so, how quickly,

remains to be seen. Traditional literacy development is a historical pointer in that direction.

At the same time, the social need for elements in what the term "community" conveys is highly visible in all these instances of Internet use. Perhaps this need has generated the hope that community will be magically and technologically engineered via the Internet, and thereby its projection into assertions about the Internet. It would be much better, however, to disaggregate these elements than to lump them together in the obscuring single metaphor of "community."

In the end, to apply the term "Internet community" as though it had a single meaning to such widely disparate groups as Blacksburg car owners, Uyghur nationalists, Punjabis segregated from each other by an artificial political frontier, TV program fans, and Americans trying to come to terms with "race," does extreme violence to the variety of meanings of community—quite apart from deifying the Internet as technical alchemy. A spectrum of senses of community, from the attenuated to the densely textured, acknowledging the roles of place and history and imagination and professional social class and global connections and conflict, is the most likely route to shed light on what is happening on the Internet in the realm of social connectedness.

ENDNOTES

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1. Blood of the Condor was directed by Jorge Sanjinés, Bolivia, 1969.

2. The charge given to me by the Aspen Institute to address the theme of "community and the Internet" proposed that telecommunications are supplanting face-to-face communications in the formation of communities. Any discussion of such a stark claim necessitates a clear initial definition of "community."

3. As in German sociologist Ferdinand Toennies' classic distinction between *Gemeinschaft* and *Gesellschaft*, interacting community versus anonymous industrial system. (*Gesellschaft* can mean both society and corporation.) I guess the "warm fuzzies" sense would actually better convey the word *Gemütlichkeit*, that almost implicitly bar-related word for cozy companionship that has no exact English equivalent (unless it's the warm fuzzies!). But "community" does very often carry this sense in actual use.

4. As in: "the international community will stand firm against terrorism." (*What international community*?) Or: "community decency standards" on pornography. ("Don't ask *me* to define them!") Or: "the intelligence community." (A lovable crowd of old hearties if ever there were one.)

5. "Communalist" is a standard term used in India to denote riots and violence between Hindu and Muslim communities. I think it well conveys the horror that "community" can bring when twisted in a certain direction.

6. A difficulty, for instance, with Jeffrey Abramson's contribution to last year's *Annual Review* of the Institute for Information Studies is that even though Abramson acknowledges at the outset the difficulty in defining the term, his own definition, when he comes to making one (pp. 63–64), repeatedly slips into deontic mode, into what *ought* to be the character of a community rather than what it actually is. See Abramson, "The Internet and Community," in *The Emerging Internet* (Queenstown, Md.: Institute for Information Studies, 1998), 59–80.

7. Jesse Berst, "What's Igniting Online Communities?" *Berst Alert*, 1 October 1998, available online at *http://zdnet.com/anchordesk/story/story_2598.html*.

8. John Hagel, III, and Arthur G. Armstrong, *Netgain: Expanding Markets Through Virtual Communities* (Cambridge: Harvard Business School Press, 1997).

9. I don't deny that grassroots computer use exists and is spreading. In the 1980s I was myself one of the first organizers of the annual Hunter College workshops, "Computers For Social Change," in New York City. See John Downing et al., eds., *Computers For Social Change and Community Organizing* (New York: The Haworth Press, 1990). But the imbalance to which I refer is still immense; see Vincent Mosco, "Myth-ing Links: Power and Community on the Information Highway," *The Information Society* 14 (1998): 57–62. This imbalance has many significant gender dimensions as well; see Leslie Regan Shade, "A Gendered Perspective on Access to the Information Infrastructure," *The Information Society* 14 (1998): 33–44.

10. Steven G. Jones, "Information, Internet, and Community: Notes Toward an Understanding of Community in the Information Age," in *Cybersociety* 2.0: *Revisiting Computer-Mediated Communication and Community*, ed. Steven G. Jones (Thousand Oaks, Calif.: Sage, 1998), 20.

11. Lee Komito offers a number of the same clarifications of "community" in "The Net as a Foraging Society: Flexible Communities," *The Information Society* 14 (1998): 97–106.

12. Kyle Nicholas, of the University of Texas, in the course of an absorbing survey of U.S. chat rooms and other sites, notes a significant related question, namely the attempt to import a sense of place into Internet groups. He writes: "How well do online communities approximate place? Those aspects of place that stimulate the collective imagination and invoke a sense of 'home' are the most important to replicate online. Certainly virtual landmarks, community symbols, regional dialects, and other more subtle visuals—architectural style, landscape palette—can be approximated in Web page design." Kyle Nicholas, "Talking about Communities," unpublished paper prepared for the annual meeting of the International Communication Association, San Francisco, 1999.

13. Benedict Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism* (London: Verso, 1983).

14. In 1988 a Serb professor told me that Franz Josef Strauss, formerly German Foreign Minister, had earlier that year called in the Yugoslav ambassador to express his own concern about fissiparous trends in the then-imagined federal community of Yugoslavia. The ambassador sought to reassure Strauss that the different ethnic components of his federal republic had many disagreements, but would instantly unite if faced with attack from outside. "But what," asked Strauss, alluding to the rapidly changing Soviet Union, "if there is no attack?"

15. Charles Husband, "Differentiated Citizenship and the Multi-Ethnic Public Sphere," *Journal of International Communication*, forthcoming; and Husband, "The Right to be Understood: Conceiving the Multi-Ethnic Public Sphere," *Innovation* 9, no. 2 (1996): 205–211.

16. Robert Putnam, *Making Democracy Work: Civic Traditions in Modern Italy* (Princeton: Princeton University Press, 1993).

17. Mark S. Granovetter, *Getting a Job: A Study of Contacts and Careers*, 2nd ed. (Chicago: University of Chicago Press, 1995).

18. Komito, "The Net as a Foraging Society."

19. It's going to get fussy and irritating if I keep sticking quotation marks around the word "community," but please mentally intrude them anyway.

20. Michael Cohill and Andrea Lee Kavanaugh, eds., *Community Networks: Lessons from Blacksburg, Virginia* (Norwood, Mass.: Artech House, Inc., 1997), 23.

21. Cohill and Kavanaugh, *Community Networks*, 23.

22. An infuriating feature of the book is that the town's population is barely analyzed. The 36,000 population of Blacksburg is left unstated until page 310, though on page 20 the university campus is enumerated at 30,000. This is clearly a real "college town." But how does its hinterland interact with it, and what are the implications for Internet and community? Defining a population center strictly by its administrative boundaries is very unhelpful for many purposes, not least the questions of access and connectivity. Would BellAtlantic, the major infrastructure provider, have been half so interested in a non–college town?

23. "Cultural capital" is a handy term coined by French sociologist Pierre Bourdieu to denote the accumulated information passed on within upper-middle-class families about how to navigate professional, business, or government everyday cultures successfully. It includes both formal education and unofficial codes of conversation, allusion, caution, leisure habits, and more.

24. Cohill and Kavanaugh, *Community Networks*, 313.

25. Morris Janowitz, *The Community Press in an Urban Setting*, 1st ed. (Chicago: University of Chicago Press, 1952).

26. Alison Macor, "Play MSTie for Me: Defining the Online Fan Community of *Mystery Science Theater 3000*," unpublished paper.

27. Face-to-face communication is available among groups of fans who intermittently meet together to watch the show together, or at *MST3K* conventions in Minneapolis, or at tours to college campuses where cable TV is minimally available.

28. My discussion does not use the group's actual name. Access to the chat group is controlled for obvious reasons, given the persistence of virulent anti-Semitism.

29. Walter Benjamin, "Theses on the Philosophy of History VI," in *Illuminations* (London: Fontana, 1973); Benjamin was probably referring to the Nazi regime's digging up and destruction of the burial place of political activists Rosa Luxemburg and Karl Liebknecht, who had been murdered in 1919 by proto-Nazis, with the then–German government full of blind eyes and deaf ears.

30. Troy Barber, "In Search of the Right Cultural Stuff: Attempts by Uyghur Intellectuals to Formulate Uyghur Ethnonationalist Identities," masters report, Center for Asian Studies, University of Texas, 1997.

31. Officially, the Uyghurs have been named part of an "Autonomous Region" since 1955. Officially, too, the Soviet Constitution guaranteed all kinds of human rights.

32. Oil, coal, and a slew of other valuable raw materials are extracted in Xinjiang; there is also a substantial Han settler presence and a large military presence to boot.

33. This was not genocide.

34. When at Partition the Hindu middle class migrated and was in turn replaced by middle-class Muslims, the new arrivals did not necessarily treat their co-religionists any better, over time often dispossessing them economically as well as politically.

35. Nabeel Zuberi, "Nationalism on the Net," unpublished paper delivered to the Business School, University of Auckland, New Zealand, 1998. Zuberi has studied Sindhi Internet usage with Dr. Saghir Shaikh, computer engineer and Sindhi netizen, of Sacramento, California, to whom my thanks are also due for information on this instance of Internet use and community.

36. Allucquère Rosanne (Sandy) Stone, *The War of Desire and Technology at the Close of the Mechanical Age* (Cambridge: MIT Press, 1995).

37. Richard Cutler, "Creation and Maintenance of Identity in a Voluntary, Text-Based Electronic Forum on the Internet," doctoral dissertation, University of Texas, 1998.

38. Michel Marriott, "Frank Racial Dialogue Thrives on the Web," *The New York Times*, 8 March 1998.

39. As African American writer Lee Stringer has recently observed: "I'm sure most Americans take comfort in the fact that racism has been abolished in this country. Not the practice, of course, but as a topic for public discussion" (cited in *The Austin Chronicle*, 29 January 1999, 42).

40. Aviva Rosenstein, "Contradictory Social Contexts of the World Wide Web: The Paradoxical Implications of the Personal Home Page," unpublished paper prepared for the annual meeting of the International Communication Association, San Francisco, 1999.

41. Malcolm Gladwell, "Six Degrees of Lois Weisberg," *The New Yorker*, 1 January 1999, 52–63. I am grateful to Kyle Nicholas for drawing my attention to this article.

CYBERCRIME, CYBERTERRORISM, AND NETWORK WARFARE:

THE NEXT GENERATION OF CONCERNS FOR USERS OF NETWORKED INFORMATION SYSTEMS

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If you know the enemy and know yourself, you need not fear the results of a hundred battles. If you know yourself and not the enemy, for every victory gained you will also suffer a defeat. If you know neither yourself nor the enemy, you will succumb in every battle.

—Sun Tzu
The Art of War

The "Information Revolution" has produced a period of dramatic and profound change throughout the world. This change is marked by rapidly advancing computing power, increasingly pervasive network technologies, and the escalating need to share information, to learn, and to act quickly. Industries and other organizational forms are converging, causing traditional lines of demarcation to blur. Lean, flexible management structures and small, focused development teams characterize new organizational structures. Radical changes in education, work, manufacturing, sales, marketing, shopping, money, tourism, entertainment, and medicine and health care are upon us. This revolution inevitably means the emergence of new cultures and societies in a space unbounded by geography or time. But this revolution also means a widening of the gap between the "have" and "have-not" societies of the

Information Age, with the attendant probability of friction sufficiently great to result in some form of hostilities. But, those of us at the forefront of this revolution are not guaranteed invulnerability from other quarters. For the past few years a heated debate has raged about the growing dependence of individuals, societies, and nations on networked information systems,[1] about the vulnerability of those systems to attack, and about the susceptibility of those systems to disaster. Much of the debate centers on the idea of "trust," that is, the expectation that a system will provide its intended functionality within a stated level of confidence. Factors that impinge on this level of confidence include environmental disruption, user and operator errors, design and implementation errors, and attacks by hostile parties. This chapter focuses on the last of these issues, focusing specifically on an emerging family of threats to networked information systems and the national-security implications associated with these threats.

The Committee on Information System Trustworthiness, convened by the Computer Science and Telecommunications Board of the National Research Council, articulated the need for concern:

> The security of our nation, the viability of our economy, and the health and well-being of our citizens rely today on infrastructures for communication, finance, energy distribution, and transportation. All of these infrastructures depend increasingly on networked information systems.[2]

The report of this committee joins a number of other national studies[3] that have addressed issues such as network security, information warfare,[4] and critical-infrastructure protection. To one degree or another, all these studies have focused on the expected shape and consequences of widespread network attacks, how to defend against information warfare and other cyber-threats, and the role of federal and private-sector actors such as the Department of Defense and the telecommunications industry. A common theme that runs through these studies is that the fundamental nature of networked systems threats is changing. A "threat,"[5] in this context, can be seen as any antagonist having both the capability and motivation to exploit system vulnerabilities (i.e., faults or weaknesses in the design, implementation, or operation of a system). Associated with the idea of the changing nature of threats to

networked systems is the obvious inference that the intelligence systems, tactics, security procedures, and equipment that were designed to deal with existing threats must either be replaced or must now deal with a new generation of threats.[6]

Given the increasing number of users and operators who are "system dependent," and in many cases technologically unsophisticated, it should come as no surprise that networked systems have fallen prey to criminal activity as well as other actions aimed at everything from corporate competition to intelligence gathering by national governments. It should also come as no surprise that as networked systems have evolved, so too have the tools, tactics, and operating practices of those individuals or groups who "attack" those systems. In large part, what is seen as the *current* generation of threats has to do with continuing technological advances and the costs that must be borne by providers, users, and the public at large. The *next* generation of threats, however, appears to be more closely related to the intrinsic characteristics and qualities of networked information systems themselves. In large measure, this change is due to the fact that these systems function in a manner independent of, and not amenable to, traditional (state-imposed) control mechanisms,[7] whether internal (e.g., police actions) or external (e.g., military actions). Thus, while the first generation of threats may be seen as controllable, the next generation is far more problematic. This is, of course, not the only difference, but from a national-security perspective it is *the* difference.

In very simple terms, the first generation of threats can be seen primarily as the actions of individuals or small, poorly organized groups, with very limited and in some cases trivial motives. For the most part, the first generation of network threats is related to problems such as inadvertent disruptions of service, network break-ins, spoofing, password sniffing, e-mail bombs, and hacking. There has also been a limited amount of criminal activity such as child pornography, credit-card fraud, software piracy, industrial espionage, and acts by disgruntled persons. While such activities are no doubt serious, they do not represent a true threat to national security.

In contrast, it would appear that the next generation of threats represents an entirely different level of exposure, involving more sophisticated attacks by organized crime and cyberterrorists, along with various forms of electronic aggression that do have an impact on national secu-

rity. The next generation of threats can be related to problems such as access control, foreign code and application-level security, and denial of service. In general, the next generation of threats can be seen as far more organized and purposeful actions, carried out by larger groups, with far greater resources at their disposal. And the motivation behind the attacks will be anything but trivial.

While it is always difficult to predict what exactly may occur as networked information systems mature, it is possible to identify certain trends. Within this context, the next generation of threats can be classed into three broad categories: the first is what may be seen as a more organized form of "cybercrime"; the second is a form of aggression that has been termed "network warfare"; and the third may generally be classed as "cyberterrorism." Table 1 provides an overview of what may be seen as the current and next generation of concerns. The table was constructed from a number of sources, including U.S. Defense Intelligence Agency (DIA) estimates, and provides an indication of the kinds of threats we may expect to encounter, now and in the near future. The table also indicates how real the threats may actually be ("validated" or "not validated"); estimates how widespread the threats might be now and in the future ("limited" or "extensive"); and assigns a rough timeline for when we might expect to see indications of these threats ("existence likely by 2005" or "existence unlikely before 2005"). The table paints a picture that is less than assuring for networked information users, because it suggests that the attackers are becoming more sophisticated, more diverse, and in all likelihood more numerous. While it is possible to question the veracity of such estimates, most studies that have considered the issue agree that such threats are real and pose a legitimate danger.

CYBERCRIME

Cybercrime has the potential to adversely affect a very large number of networked information system users. The problem is that cybercrime is frequently difficult to recognize, or in some cases even to acknowledge, because cyberspace has no common ethical code:

> The boundaries of acceptable behavior, or even ethical behavior, in cyberspace are not yet clearly defined.

> Nor does there exist a consensus on what types of information can and should be considered property on the network, and what constitutes theft or interference with this property.[8]

Even when computer network users and law enforcement officials can distinguish between illegal or deliberate network abuse and behav-

Table 1: Real and Potential Concerns Affecting Internet Trustworthiness

	Validated Existence	Existence Likely but not Validated	Existence Likely by 2005	Existence Unlikely before 2005
CURRENT-GENERATION THREATS TO THE INTERNET				
Unintentional Damage	Extensive			
Hacking/Software Piracy/ Spoofing/Password Sniffing, etc.	Extensive			
Acts by Disgruntled Employees	Extensive			
Individual Criminal Acts	Extensive	Extensive		
Industrial Espionage			Limited	Extensive
Corporate and Foreign Government Intelligence Gathering	Limited	Limited	Extensive	
NEXT-GENERATION AND BEYOND THREATS TO THE INTERNET				
Organized Criminal Activities	Limited			Extensive
Attacks by Political Dissidents		Limited		
Attacks by Terrorist Groups		Limited	Extensive	
Foreign Espionage	Limited		Extensive	
Adverse Effects of Tactical Countermeasures		Extensive		
Disruption of Infastructure Denial Attacks (Routing/ Database Attacks, Name Server Attacks)			Limited	
Psychological Attacks Corporate and Government			Limited	
Tactical Net Warfare				Limited

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ior that is merely inept or annoying, legal definitions and remedies may not exist. When they do exist, they are by no means universally applied. As Mark D. Rasch indicates, the traditional concepts of criminal theft, trespass, and destruction of property do not work well in the realm of cyberspace.[9] In the United States, both federal and state legislatures have enacted specialized statutes to deal with the problem of unauthorized use, access, and manipulation of computers or computerized data, but these statutes become obsolete very quickly as changing technology and behavior outpace changes in the law. Thus, while numerous boards and commissions have been impaneled to discuss cybercrime, society has barely begun to deal with even the current generation of threats.

Crucial for those struggling with cybercrime threats is the question of how well law-enforcement and legal institutions are capable of dealing with information as property, including such issues as wire fraud and interstate transport, theft of services and trade secrets, electronic trespass, electronic privacy, and destruction or alteration of property that exists only in electronic form. A number of high-profile cases are illustrative of the vagaries that plague the legal and judicial systems and make these kinds of crime so difficult to control. In one such case, a notorious hacker was arrested for allegedly breaking into the home computer of a computer security expert, "spoofing" his way through an elaborate security blockade, and stealing computer security tools to distribute over the Internet.[10] Despite an abundance of evidence, the case could not be properly prosecuted. A more worrisome aspect of the case, especially for network security professionals, is that hacking "for fun" is being supplanted by hacking for profit as freelancers, businesses, governments, and intelligence agencies turn to computer networks to facilitate both legitimate and criminal activities. Anthony Cajigas, like others who have examined the issue, believes that the future of organized crime is "information crime."[11] Organized crime is already the largest industry in the United States, and it is naïve to believe that organized crime will not extend its reach into cyberspace. Within the terms of how wealth is generated and technology is employed lies a vacuum of untold profitability and power. If organized crime cartels fail to adapt, organized crime as we know it could very easily be supplanted by faster-growing "information cartels" staffed with information-savvy criminals.

Speculation on the scope of future problems varies widely, but as computer technology alters the way people conduct business and interact with each other, society can expect further changes in the way computer crimes are committed. We are now seeing cases of computer stalking,[12] computerized threats, and electronic extortion. But these activities pale in comparison to what is expected to emerge as the next generation of cybercrime. Security experts predict attacks (or the threat of attacks) on computer centers, electronic fraud on international funds-transfer networks,[13] corporate and government espionage on business networks,[14] and professional crackers breaking into systems that control essential business or national infrastructure elements. The trend is simple to deduce: computer criminals are becoming more technically sophisticated, and it will be an increasing challenge to keep pace with their methods.[15] In the hands of a skilled and unscrupulous individual, a personal computer and a simple telephone connection to an Internet Service Provider anywhere in the world are enough to cause a great deal of harm. But this idealization of "the threat" is giving way to a far more chilling idea: skilled individuals working for illegal or unscrupulous organizations causing widespread damage. The fact that organized crime syndicates are capable of operating in a networked environment, and the fact that they pose a threat to networked systems, are reality. According to FBI reports, organized crime figures regularly buy and sell information concerning threats, resources, potential scores, and likely suppliers, buyers, and sellers of merchandise. To remain competitive, organized crime may transform or leverage its power by tapping into a new layer of information resources.[16] The problems this raises for law-enforcement agencies become even more intractable in light of the global nature of networked information systems.[17] But beyond the specter of criminal activities in global finance markets, the same techniques that characterize cybercrime can be used for other illegal activities from terrorist attacks to industrial espionage to network warfare. Indeed, one of the emerging tenets of "information warfare" is that non-government entities or non-state actors can carry out such actions to the point of becoming a viable national defense threat.[18] Certainly, organized crime could easily use network warfare techniques to efficiently steal data from government or the private sector and provide that information, for a price, to a selected group of clients.[19]

NETWORK WARFARE

"Network warfare," or "netwar"[20] refers specifically to an information-related conflict at a grand level between nations or societies. Network warfare involves disruption or damage to the knowledge a target population has (or thinks it has) about itself and the world that surrounds it. A netwar is intended to focus on a society's public at large and/or its leadership elements. It may involve diplomacy, propaganda, and psychological campaigns, political and cultural subversion, deception techniques or interference with local media, infiltration of computer networks and databases, and efforts to promote dissident or opposition movements across computer networks.[21] It is quite simply a societal-level conflict, waged in part through networked modes of communications.

> In terms of conduct, netwar refers to conflicts in which a combatant is organized along networked lines or employs networks for operational control and other communications. The organizational forms that netwar actors adopt may resemble "stars" that have some centralized elements, or "chains" that are linear, but the major design will tend to be "all-channel" networks in which each principal node of an organization can communicate and interact with every other node. Further, netwar actors may develop hybrid structures that incorporate elements of some or all of the above designs in varied ways. Strong netwar actors will have not only organizational, but also doctrinal, technological, and social layers that emphasize network designs. Netwar actors may make heavy use of cyberspace, but that is not their defining characteristic—they subsist and operate in areas beyond it.[22]

The rationale for any national or subnational entity to enter into netwar activities is obvious. Because networked information systems can be incredibly powerful tools for achieving economic, political, or social objectives, it is only reasonable to believe that they will become instruments that both state and non-state actors will use to further their goals. But netwar is by no means a straightforward proposition, because even though its organizational and communication elements are easy to

understand, the advantages and disadvantages of using networked systems as weapons or control instruments are less well understood. This fact has not, of course, stopped a flood of activity in preparation for offensive and defensive network warfare.[23]

Because modern societies, particularly those of the West, are the most heavily invested in networked systems, they are seen as the most vulnerable and the most likely to become involved in network warfare activities. Col. Richard Szafranski suggests that the more dependent a nation or society is on networked information systems, the more vulnerable that nation or society is to the hostile manipulation of those systems.[24] But there is no reason to believe that network warfare will become commonplace or that the first confrontations will take place between advanced societies. The opposite may be true, and for two very good reasons. First, because network warfare can be prosecuted against an opponent's entire epistemology, even agrarian or primitive societies are vulnerable. Second, less-advanced civilizations (i.e., primitive, agrarian, or industrial societies or groups) are dependent for much of their essential information, as well as for the supporting communications infrastructure that delivers that information to them, on more advanced societies or groups. This dependency may in turn be exploited. And in the case of advanced societies or groups, attacks against the information infrastructure or telecommunications systems of a less-capable adversary can wreak havoc with that adversary's ability to make effective decisions in business and commerce, diplomacy, warfare, or any manner of relations with other states or groups. Thus, we may see more advanced societies using network warfare extensively as a tool of statecraft. After all, in any confrontation (military or otherwise) exploiting an opponent's vulnerabilities is key to achieving one's own objectives.

Michael Wilson argues that—at least in the near term—network warfare attacks are likely to take three forms: denial of service, psychological aggression, and encouragement of political opposition or dissent.[25]

- *Denial attacks* may involve the physical destruction of a system or some form of electronic corruption, usually involving computer viruses. An aggressor might use physical weapons[26] or syntactic weapons[27] to accomplish these goals. As an example, denial might take the form of a malicious attack on the tele-

phone system, aimed at destroying databases or routing capability. Or it might involve attacks on name or routing servers, aimed at disrupting or eliminating service. Communication systems are vulnerable to attacks of both kinds, the only difference to an attacker being which technique is more likely to achieve the desired effect, in the least amount of time, for the least amount of money, with the lowest risk.

- *Psychological aggression* is designed to subvert decision-making or automation. Warring forces have long employed deception and the creation of illusion to achieve certain aims, but when information and knowledge are the critical commodity, such attacks become the equivalent of poisoning the wells and salting the earth. In psychological aggression, the whole idea is to misrepresent events in such a way as to create diversions or produce decisions that unwisely favor a specific course of action. A psychological attacker might use either syntactic or semantic weapons in such an attack. Syntactic weapons, like viruses, may be used to corrupt networked systems by destroying or degrading code or data; semantic weapons are used to affect and exploit the trust users have in the information system and the network, as well as to affect their interpretation of the information it contains.[28]
- *Encouragement of political opposition or dissent* is an emerging technique of network warfare related to fomenting potential resentment among the leaderships of groups, organizations, nation states, or alliances of states. The core tenet of networked information systems is global cooperation, but the extent to which global cooperation (including competition) is possible is still very much in doubt, and thus is open to exploitation.[29] In part network warfare involves new media, and in part it involves the use of propaganda techniques as an instrument of state or subnational policy and the use of information to affect the perceptions, intentions, and orientation of others. Politicians, advertisers, journalists, radio personalities, and others who are interested in influencing human behavior regularly apply these persuasive techniques.

While network warfare may be seen as a limited form of conflict, it does not mean that those involved have limited aims. Rather, this shift in the metaphor of warfare simply means that conflict is no longer constrained to military or police actions. In large part, this new phenomenon is due to geopolitical realities that are likely, as an example, to encourage aggressive regional powers to abstain from blatant aggression in favor of indirect strategies, including the sponsorship of low-intensity conflicts. The fact that a regional power could contemplate a strategy such as network warfare is possible only because inexpensive commercial technologies like satellite-based personal communications devices, encrypted fax machines, and networked information systems can and do provide credible "force multipliers" for irregular forces. At the strategic level, many within national defense establishments believe that the military has scarcely begun the intellectual revolution necessary to comprehend the quantum leap in combat effectiveness (potentially) offered by information technologies. Beyond the purely military challenge, however, we must consider the fact that the growing dependence of modern societies on computer-controlled information infrastructures has opened up new areas for unconventional warfare.

CYBERTERRORISM

Between cybercrime and network warfare is a class of activities that may best be described as "cyberterrorism." Trying to clearly differentiate cyberterrorism from other kinds of network attack may be a futile exercise. Perhaps the simplest description is that ideological considerations, rather than economic or political considerations, motivate these attacks. But whether an attack is ideologically, politically, socially, or economically motivated, the idea remains the same: to affect the decision-making elements of national or group power. And terrorism can be an extremely effective tool for shaping that response. The growing dependence of modern societies on computer-controlled information infrastructures has opened up new areas for unconventional warfare. And while we may not be subjected to actual network warfare in the immediate future, the recent intrusions into civilian and military computer networks by hackers and criminals only hint at far more serious disruptions that could be wrought by systematic electronic sabotage

of national telecommunications systems, power grids, and financial institutions.[30] Such attacks are low-risk endeavors for the perpetrators, but can result in high payoffs. Because they can be conducted remotely, they offer the prospect of inflicting indiscriminate damage on millions of people.

Network terrorism is a special case of terrorism in which actions are taken against electronic communications. Whereas guerrilla warfare operations focus on institutional targets (such as military infrastructures, war materiel, money and finance, command-and-control elements, supplies, and staging areas), terrorist operations focus on recognition, coercion, intimidation, provocation, insurgency support, ambushes, raids, assassinations, bombings, kidnappings, riots, and hijackings. Terrorist targets tend to be civilian in nature, which is one way they can be distinguished from targets of guerrilla actions. Like crime and warfare, terror attacks have also evolved. First-generation terror efforts focused on a strategy of exhaustion. Targets were typically no-retreat hostage situations, which eventually were successfully overcome by improved police methods and commando strikes. The next generation of terror attacks will be aimed at recognition and coercive propaganda, and targets will be no-contact profiles. First-generation terrorist attacks were seen as the acts of individuals and counter-measures were focused on criminalization of the actors and their actions and denial of any valid political element. Second-generation terrorist activities, in many cases, will be state-sponsored or -sanctioned; effective countermeasures may require confronting the supporting state. This new dynamic will make it very difficult to confront terrorism, and attacks that are not easily seen to be sponsored or connected to a state or established organization may ultimately prove to be the most pernicious form of confrontation.

Two very disturbing general trends in terrorism have become increasingly apparent over the last decade. The first trend is clearly toward the use of more lethal weapons. Throughout the world, the use of materials that have the potential for mass destruction is an issue of growing concern. Although only a few such attempts or attacks have actually been aimed at information systems, all indications are that we may expect future attacks on critical infrastructures to be as lethal as possible. The second trend pertains to the actual targets of terrorist attacks. Here, there has been a shift away from "hard" targets (i.e., military targets or well-defended civilian targets essential to the well-being

of the state) toward "soft" targets (i.e., poorly defended targets or otherwise innocent civilian targets) like networked information systems. In the case of "soft" targets, it is clear that the damage to a society or segments of a society can be very high, and not just in terms of the dead and wounded. Terrorism, by definition, is aimed at a wider audience than its immediate victims. To a large extent, this is due to the fact that terrorists can command a worldwide audience for their crimes and cause great disruption, fear, and economic damage. But finding any sort of clear "pattern" in all this is extremely difficult. While most analyses of cyberterrorism focus on the threat posed by foreign terrorist groups, the most likely perpetrators are domestic organizations with anti-government attitudes. The most probable threats are identified as trusted insiders who may destroy a system from within by sabotaging equipment during transport or storage, by network penetration and compromise, by electronic and/or physical attack, and by empowered autonomous agents (network attack over time). But this does not mean that cyberterrorism will be limited to attacks on legitimate governments only. We could very easily lapse into a situation where one terrorist group seeks to attack another terrorist group, with the possibility of collateral damage. The reasons are mainly ideological, and the same factors that would motivate skilled individuals capable of causing widespread damage through information networks to work for foreign terrorist organizations could also bring them together with domestic terrorist groups. While some of these individuals might be financially tempted to assist conventional terrorist organizations, they are not generally ideologically predisposed to do so. On the other hand, the anti-government message of the domestic militia movement might have more appeal to those individuals who identify with hacker culture. The importance of this distinction is that cyberterrorism is often discussed as a foreign threat when in fact the domestic threat may be more significant.

Low-intensity political, ideological, or religious violence represents a threat to national security and the subversive connotations of the term "terrorist" have been connected with many acts of computer abuse. Acts of cyberterrorism can range from the use of personal information for extortion to hacking into a network to physical and/or electronic destruction of a networked information system. While this may be far too simplistic a taxonomy for such a complex phenomenon, labeling every malicious use of a computer system as an act of terror-

ism only serves to increase confusion. The preoccupation with "hackers" and "crackers" does little except instill panic among users, and it frequently hinders prosecution and prevention by blurring the motivations behind the crime. Ideologically motivated, as opposed to economically motivated, attacks have vastly different implications for national security and defense policy. Terrorism is an attack on the legitimacy of a specific government, ideology, or policy, whereas hacking into a system to erase files or steal information is nothing more than simple theft, fraud, or extortion. Policies and methodology to counter crime depend a great deal upon divining and countering criminal motivations. Likewise, policies aimed at curbing terrorist attacks must be aimed at the motivations that spawn such attacks. As the concepts that surround the next generation of threats to networked information systems mature, a clearer and more concise definitions of cyberterrorism is needed if it is to be addressed by either national security policy or police actions. Attacking the legitimacy of a government or its policies would typically not fall within the activities of a computer hacker or even a common criminal. However, the quasi-criminal, quasi-military nature of terrorism blurs the distinction between crime and warfare. Distinctions between law enforcement and military operations become equally blurred, and may only be clarified through a coherent policy dictating those actions, based upon a clear understanding of the threat.

MOVING CAUTIOUSLY INTO THE FUTURE

The Committee on Information System Trustworthiness concluded that a gap exists between the state of the art and the state of the practice in network security.[31] In large part, this gap results from the workings of the market, existing policies regarding cryptography, ignorance about the real costs of trustworthiness to consumers and producers, and the difficulty of measuring trustworthiness. But there is also a gap between the needs and expectations of the user community and the existing science and technology base for building trustworthy systems. The use of common, extensible components, the expectation of growth by accretion, and the likely absence of centralized controls, trust, or authority, all necessitate a new look at risk mitigation rather than risk avoidance. While society has arrived at a point where the problem has been iden-

tified, it has yet to accept the problem as real, much less formulate an approach for dealing with it. A more robust security strategy may involve adopting technologies to hinder attacks rather than prevent them outright, or it may involve add-on technologies and defense in depth, or a relocation of vulnerabilities rather than their elimination. Other aspects of trustworthiness also demand progress and will require new thinking, because the networked environment and the scale of interconnected systems impose novel constraints. What appears obvious is that network trustworthiness must be dealt with as a multidimensional attribute of the entire infrastructure, and going beyond what is known today will require breakthroughs in research.

At its heart, the considerations discussed in this chapter represent a family of threats to the continued expansion and usefulness of a vital infrastructure. At another level, however, they represent new national-security concerns. In truth, the only difference between them lies in the motivation for an attacker: cybercrime attacks are economically motivated, network warfare attacks are primarily political, and cyberterrorism attacks are primarily ideological. To the extent that a threat exists, that threat is about people, both as individuals and as societal configurations. It is about their objectives and priorities, and it is about their vulnerabilities and fears. Any discussion about the consequences of a network attack must be tied to a realistic assessment of who is affected by the end result and to what extent. While the catastrophic failure of a system may be seen as something that must be avoided at all costs, there are many dimensions to trustworthiness and the consequences of a network attack may involve various outcomes, each with varying degrees of severity. Understanding the consequences of a network attack is essential to forming a baseline of expectations for public and private actions and what incentives may be effective for changing those actions. But that understanding is often hampered by the difficulty of quantifying or otherwise specifying the costs and consequences associated with risks.[32] Within the context of "threats" are many potential enemies, many types of weapons, and many motivations. If we look behind our predispositions and technology to understand the vulnerabilities to be addressed, we are confronted with issues about what we are actually prepared to do: to what degree are we willing to "play by the rules," and to what degree we are willing to give up aspects of our own freedom in the name of security.

Most studies have concluded that there is insufficient awareness of the threats we face, individually and collectively.[33] However, protecting our national information infrastructure will not be easy or inexpensive. From a purely technical perspective, it will be a lengthy and extremely costly undertaking that might not ensure protection for all types of sensitive data. Moreover, neither the Department of Defense nor any other federal agency currently has the legal authority to enforce information security standards in the private sector, nor do they have the ability to impose such standards. Nor is it certain whether public opinion can be induced to support risky foreign-policy ventures absent a clear threat to national interests. Attempts to do so will probably be controversial, especially in the absence of a clear external threat to national security. The unraveling of national security policy in places like Africa or protracted, open-ended peacekeeping commitments such as Northern Iraq or Bosnia illustrate the problems that can arise in this kind of environment. This is especially true when the national leadership fails to build requisite public support for any action by explaining the costs and risks of its policies. Cybercrime, cyberterrorism, and network warfare pose potential domestic- and foreign-policy complications where police or military organizations can become entangled in dilemmas of a particularly confusing kind. Since network trustworthiness involves issues that affect numerous government agencies and cuts across the public and private sectors, a case could be made for the establishment of a separate agency, or coordinating body. But establishing such an agency will also be controversial, especially if such an agency adopts a strategy that sanctions, or appears to sanction, activities aimed at any group or sovereign nation. Operations undertaken by the United States for the purposes of compelling or deterring network attacks might well be considered attempts at hegemony, exposing the nation to international criticism and possible retaliation in kind.

Networked information systems have provided us with all manner of wonderful things, but there is a price to be paid when the consequences of a network failure include the possibility that lives may be threatened, valuable assets may be lost or damaged, and essential services may be unavailable. While the exact consequences of cybercrime, cyberterrorism, or network warfare attacks may be unknown until networked systems actually come under attack, it is safe to say that the end

result of those attacks may be terribly harmful. And we certainly cannot rule out the possibility that tactical countermeasures designed to protect against network attacks may adversely affect other parts of the network in a way that inflicts as much damage as the attack itself. Unfortunately, the inability to accurately predict the consequences of cybercrime, cyberterrorism, and network warfare seriously complicates the process of calculating risk and implementing adequate countermeasures. It also make it very tempting to assume either "worst-case" or "best-case" scenarios to justify risk-avoidance or risk-management strategies. With this in mind, it is only prudent that we proceed cautiously, as a nation and as individuals, so that we do not over-react to perceived threats in a way that does more harm than good, or fall victim to a myopic view that all is well. A successful national-security strategy aimed at cybercrime, cyberterrorism, and network warfare requires that we balance the ends, ways, and means with a well-defined set of policy objectives. Not protecting our networked systems is an unacceptable option. Isolating or otherwise denying access to networks in hopes of preempting attack is totally counterproductive because it accomplishes an adversary's mission. So we find ourselves (as a nation and as individuals) in the uncomfortable position of having to reinvent a security apparatus and a strategy for ensuring network trustworthiness. This will involve adequate levels of research and development, and partnerships between government and industry. Successful strategies for countering cybercrime, cyberterrorism, and network warfare will require a mastery of information networks, which operate on a win-win philosophy. The more our national interests reflect those of the networks, the more likely our chances will be of achieving them.

ENDNOTES

1. The term "networked information systems" was adopted because it allows for the inclusion of voice, video, and data. The term is considered less restrictive than a term such as "the Internet." Networked information systems integrate computing systems, communication systems, system users and operators, and procedures. The term specifically relates to a class of systems that act primarily as interfaces to other systems and whose defining elements are their control algorithms, communication, and interaction.

2. Committee on Information Systems Trustworthiness, National Research Council, *Trust in Cyberspace*, ed. by F. B. Schneider (Washington, D.C.: National Academy Press, 1999), 12. The study committee included experts on computing and communications systems from industry and academia whose expertise spanned computer and communications security, software engineering, fault-tolerance, systems design and implementation, and networking. The committee solicited input and discussion from key officials in its sponsoring agencies, other government officials, academic experts, and representatives of a wide range of developers and users of information systems in industry. The committee did not make use of classified information, believing that detailed knowledge of threats was not important to the task at hand. The committee first met in June 1996, and subsequently met on eight other occasions. The committee has tracked the progress of relevant activities in the legislative and executive branches in government, including the President's Commission on Critical Infrastructure Protection, Critical Information Assurance Office, and congressional hearings. They have also sought input from other governmental and quasi-governmental organizations with relevant emphases. Additional inputs included perspectives from professional conferences, technical literature, and government reports gleaned by committee members and staff.

3. See *Cybernation: The American Infrastructure in the Information Age. A Technical Primer on Risks and Reliability* (Washington, D.C.: Executive Office of the President, 1997); *Reports from the Eight NSTAC [President's National Security Telecommunications Advisory Committee] Subcommittee Investigations* (Washington, D.C.: NSTAC, 1997); *Critical Foundations: Protecting America's Infrastructures* (Washington, D.C.: President's Commission on Critical Infrastructure Protection, 1997); *Report of the Defense Science Board Task Force on Information Warfare Defense* (IW-D) (Washington, D.C.: Defense Science Board, 1996); and *Information Security: Computer Attacks at Department of Defense Pose Increasing Risks: A Report to Congressional Requesters* (Washington, D.C.: U.S. GAO, 1996).

4. "Information warfare," as it is presently understood, embraces a number of ideas that are not completely distinguishable. It has been used to refer to everything from computer viruses to "smart" bombs to intelligence-gathering techniques and data fusion to psychological operations, and it can encompass the activities of people as diverse as business executives, terrorists, computer hackers, and professional soldiers. For many in the defense community, "information warfare" simply refers to the battlefield application of information systems and other technologies, along with the organizational, operational, and doctrinal changes these technologies necessitate. For others, it has evolved into a much broader concept, related to the emergence of a new "Information Age" civilization and the development of associated modes of political, economic, and social conflict. The ambiguity of the term is further increased by the common tendency to employ it or similar terms more or less interchangeably, with a variety of descriptors such as "cyberwar," "netwar," "Third Wave warfare," "po-mo [post-modern] war," and "post-industrial warfare."

The debate over "information warfare" as a "new form of warfare" centers on the fact that information systems are subject to "territorialization," in both the literal and figurative senses. However, once a sufficiently large number of information systems have been integrated in a network configuration, some very interesting dynamics appear to take over, affecting the way in which the system functions. The "information" within the system is no longer constrained by parameters such as a unique locus or finite production. What this means is that within some non-physical space (as opposed to the physical system itself), the operative metaphysical considerations and the dynamics of information become distinctly different from those of the physical system. This in turn implies that the means for leveraging one's own interests (e.g., tools, tactics, etc.) in a non-physical information space will be (or at least can be) qualitatively different from the means applied to leveraging one's interests in a physical system. Once you have accepted the existence of a non-physical information space, the distinction between information requirements in support of military operations versus denying or managing information to achieve a military advantage can be clearly shown. Information warfare, as it is currently envisioned, employs physical, syntactic, and semantic techniques to deceive, deny, exploit, damage, or destroy an adversary's information space, while at the same time protecting the information space that surrounds or includes friendly information.

5. See "Threats to U.S. National Security," Statement for the Record before the Senate Select Committee on Intelligence by Louis J. Freeh, Director of the FBI, 28 January 1998.

6. B. C. Collin, "The Future of Cyberterrorism: Where the Physical and Virtual Worlds Converge," paper presented at the 11th Annual International Symposium on Criminal Justice Issues, Chicago, August 1998; available online at *http://www.acsp.uic.edu/OICJ/CONFS/terror02.htm*.

7. See J. A. Warden, "The Enemy as a System," *Airpower Journal* 9, no. 1 (Spring 1995): 41–55.

8. Mark D. Rasch, "Criminal Law and The Internet," chapter 11 of *The Internet and Business: A Lawyer's Guide to the Emerging Legal Issues*, ed. by Joseph F. Ruh, Jr. (Fairfax, Va.: Computer Law Association, 1996); available online at *http://cla.org/RuhBook/chp11.htm*.

9. Rasch, "Criminal Law and the Internet."

10. The arrest of Kevin Mitnick, depicted by the media as a renegade in cyberspace, has sparked a national debate about what laws apply in cyberspace. Was Mitnick simply a harmless hacker out to satisfy his intellectual curiosity? Or was the high-school dropout a mischievous cracker, "a technowhiz out to profit from digital skullduggery"? Mitnick's arrest has triggered intense discussions about what constitutes right and wrong in cyberspace, even what is legal or illegal, and who will make the rules. See "Outlaws on the Cyberprairie: Recent Crackdowns

on Computer Criminals have Galvanized Debate about the Ethics of Hacking. But Not Even Hackers Agree about What's Right or Wrong," *San Francisco Chronicle*, 2 April 1995, 1/Z1.

11. A. Cajigas, "Infowar Melts with Black Marketeering in the Information Age, Creating Black Dagger" (1998); available online at *http://www.infowar.com/*.

12. The case of Jake Baker, a student at the University of Michigan in Ann Arbor, is one example. Baker was arrested by the FBI and charged with "transmitting threats across state lines." The charge was made after it was discovered that Baker had posted an erotic fantasy on the Internet in which he raped and tortured a character with the same name as one of Baker's classmates. The charges were later revised to making a "threat to injure another person," but the case raises issues beyond the legality of posting a fantasy in which a living person's name is used. Many people have expressed concern over whether Baker's civil liberties were violated when he was suspended and how much liability an individual has when posting materials to the Internet. Baker was eventually acquitted, in part because his story was determined to be "self-expression" and did not constitute a threat. The MIT Student Association for Freedom of Expression (SAFE) maintains an archive on the case, available online at *http://www.mit.edu:8001/activities/safe/safe/cases/umich-baker-story/*.

13. One example of this kind of activity was reported in the 2 June 1996 *London Times*. According to the article, a number of financial institutions were reportedly forced to pay as much as $400 million to fend off extortionists who used logic bombs to demonstrate their ability to destroy those institutions' global operations. Although officials from these financial institutions steadfastly deny reports of any such extortion attempt, the journalists who broke the story have confirmed the report, and are looking into over forty attacks on financial institutions in New York, London, and other European banking centers since 1993. The article indicated that the extortionists demonstrated their ability to halt trading via information warfare techniques and then sent an encrypted extortion message. The institutions reportedly gave in to the blackmailers' demands within hours of receiving the message, and transferred money to offshore bank accounts.

14. A report to the European Parliament, compiled by the Parliament's Directorate General for Research, contends that new surveillance technologies originally conceived for the defense and intelligence sectors have rapidly spread to the law enforcement and private sectors since the end of the Cold War. The report alleges that U.S. intelligence agencies routinely intercept all telecommunications within Europe; it reveals that Japan's leading high-tech firm NEC Corp. was among the foreign firms the U.S. agency had targeted for wiretapping. The Parliament later adopted a resolution after a discussion on an updated report on electronic surveillance, which says the U.S. intelligence agency regularly wiretaps foreign firms and uses the information to boost the U.S. position in crucial trade talks with other countries. See Steve Wright, *An Appraisal of Technologies for*

Political Control (European Parliament, Directorate General for Research Directorate B, The STOA Programme, 6 January 1998).

15. One indication of the level of sophistication with which law enforcement officials are now forced to deal can be seen in an article on how organized crime controls the market for a stock and its price by trading it among themselves: "They enforce their control through bribery, violence, and intimidation. Often what you see is organized crime manipulating stock prices and churning stock. They run the price up and then unload the stock on the public at an inflated price and, sometimes, sell it short to profit when the shares go bust." G. Weiss, "The Mob on Wall Street," *Business Week*, 16 December 1996.

16. Cajigas, "Infowar Melts with Black Marketeering."

17. "Given current technology, it is possible to route activities through countries where jurisdictional processes and legal problems can make investigation difficult. The potential for these kinds of activities is enormous. Today, banks, the stock exchange, and other financial institutions trade in vast amounts of complex financial instruments. Reams of electronic data, worth billions of dollars, are processed daily. In reality, information is the true, common currency of the money market world." Cajigas, "Infowar Melts with Black Marketeering."

18. George Tenet, Director of Central Intelligence, testified before the Senate Select Committee on Intelligence in January 1998 and the Senate Governmental Affairs Committee in June 1998: "It is clear that nations developing these programs recognize the value of attacking a country's computer systems, both on the battlefield and in the civilian arena. The magnitude of the potential threat from various forms of intrusion, tampering, and delivery of malicious code is extraordinary. We know with specificity of several nations that are working on developing an information warfare capability. In light of the sophistication of many other countries in programming and Internet usage, the threat has to be viewed as a factor requiring considerable attention by every agency of government. Many of the countries whose information warfare efforts we follow realize that in a military confrontation against the United States, they cannot prevail. These countries recognize that cyberattacks, launched from within or outside the United States, against civilian computer systems in the United States, represent the kind of asymmetric option they will need to level the playing field." See United States Information Service Washington File, available online at *http://www.usia.gov/products/washfile.htm.* This text is available online *http://pdq2.usia.gov/scripts/cqcgi.exe/@pdqtest1.env?CQ_SESSION_KEY=WMTXKUGFVGZM&CQ_QUERY_HANDLE=123999&CQ_CUR_DOCUMENT=9&CQ_PDQ_DOCUMENT_VIEW=1&CQSUBMIT=View&CQRETURN=&CQPAGE=1.*

19. The Defense Science Board report, sponsored by the DoD (Department of Defense) Joint Chiefs of Staff, included organized crime as a viable national defense threat. This inclusion "may be justified, since new [Information Warfare] techniques and tools will amplify the number of data thefts to epidem-

ic proportions. Technically, Information Warfare entails stealing, modifying, or controlling the flow of information. It also involves destroying or altering the information machinery that controls or produces that information, or worse instantaneously reacts to information." Cajigas, "Infowar Melts with Black Marketeering."

20. "Netwar represents a new entry on the spectrum of conflict that spans economic, political, and social, as well as military forms of 'war.' In contrast to economic wars that target the production and distribution of goods, and political wars that aim at the leadership and institutions of a government, netwars would be distinguished by their targeting of information and communications. Netwars will take various forms. Some may occur between the governments of rival nation-states. Other kinds of netwar may arise between governments and non-state actors. For example, netwar may be waged by governments against illicit groups involved in terrorism, proliferation of weapons of mass destruction, or drug smuggling. Or it may be waged against the policies of specific governments by advocacy groups—involving, for example, environmental, human rights, or religious issues. The non-state actors may or may not be associated with nations, and in some cases they may be organized into vast transnational coalitions. Some netwars will involve military issues, such as nuclear proliferation, drug smuggling, and antiterrorism, because of the potential threats they pose to international order and national security. Netwars are not real wars, traditionally defined. But netwar might be developed into an instrument for trying, early on, to prevent a real war from arising. Deterrence in a chaotic world may become as much a function of one's cyberposture and presence as of one's force posture and presence." Arquilla and Ronfeldt, "Cyberwar is Coming," *Comparative Strategy* 12 (1993): 141–165.

21. Arquilla and Ronfeldt, "Cyberwar is Coming."

22. Arquilla and Ronfeldt, "The Advent of Netwar," briefing prepared for a project on new modes of information-age conflict (Washington, D.C.: National Defense Research Institute, 1996).

23. The FBI reported that the governments of at least twenty-three countries including Germany, Russia, China, France, and Israel are involved in economic espionage against the United States. See Louis J. Freeh, "Threats to U.S. National Security."

24. R. Szafranski, "A Theory of Information Warfare: Preparing for 2020," *Airpower Journal* (spring 1995): 56–65.

25. M. Wilson, "Infrastructural Warfare: An Introduction" (1997); available online at *http://www.7pillars.com/papers1.html.*

26. A nation state (organization or entity) may resort to the use of physical weapons if it intends to deny service, create bottlenecks, or isolate leadership elements from the population. Physical effects may be achieved by means of directed-

energy weapons, devices, and countermeasures to either cause direct damage or destruction of enemy equipment, facilities, or personnel. Defensively, directed-energy weapons may be used to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum through damage, destruction, or disruption. Directed-energy weapons are categorized under the heading of radio-frequency weapons. They are devices that interfere with or destroy by radiating electromagnetic energy in the RF spectrum with a wavelength greater than 1 mm (frequencies less than 300 GHz). Perhaps the most open and recognizable use of this type of weapon can be seen in electronic jamming. More sophisticated types of electromagnetic weapons produce blinding or shocking effects. While much of this technology is secret, suffice it to say that a single pulse from a directed-energy weapon could have handicapped operations at the World Trade Center in a far more effective manner than did a bomb. These weapons are seen as a very important development because they enable the use of non-lethal force. In addition to directed-energy weapons, low-energy lasers can be directed or aimed at specific targets to blind personnel or sensors, either temporarily or permanently. The physical destruction of any portion of an information system could also offer complete denial of services. To this extent destruction of an information system in the conventional sense is also within the scope of a physical attack. There are a number of capabilities that are available to accomplish this, and under certain circumstances might even include traditional weapon systems such as missiles, bombs, sabotage, etc.

27. Networked information systems may be destroyed from the inside using malicious code (a virus). An attacker (nation state, organization, or other entity) may seek to create confusion or produce unwise decisions by employing syntactic weapons to corrupt a system. A computer virus is technically any piece of executable code (program) that replicates or copies itself. In the real world, computer viruses almost always have an additional element: a damage routine. The damage routine is the part of the computer virus that, when activated, will attempt to destroy or degrade some important code or data. Some viruses damage or reformat hard drives, while others may scramble the numbers in a document. Either way, they create situations that require the expenditure of both time and resources. Even computer viruses that don't have specific damage routines may still cause a great deal of trouble by taking up storage space or system memory, or by degrading system performance. This in itself is damage. Viruses can change settings and permanently damage certain hardware components; however, viruses are generally used to destroy or corrupt data files and executable programs. With respect to the denial of service, such an attack would only be temporary. Recovery would be dependent on the availability of planned disaster procedures such as having available recovery teams, mirrored and redundant systems using different hardware and software systems, or off-site/offline data storage. A number of syntactic weapons have specifically emerged in the domain of information systems and networks. New viruses are being created at an incredible rate along with specific countermeasures, or anti-viral software. Market and meta-programming environments are now available that "incubate"

viruses in accordance with the desires of an attacker. The variety and combinations are daunting. (DoD Directive S-3600.1, 1995.)

28. The study of semantics deals with how and what a sign, symbol, message, or system means to an observer; scholars of semantics are variously located in logic, linguistics, philosophy, and communication research. For some, semantics is that branch of semiotics (the study of human behavior in the process of communication) that is concerned with the relationship between signs and referents or with the constraint imposed by non-linguistic phenomena on choices among linguistic expressions.

Semantic weapons manipulate, modify, and destroy mental models, and the awareness and representations that are developed and constructed through the use of an information system. This class of "weapons" alters the decision-maker's representation of what the information system portrays to an observer as the real world. The management of perception involves actions that convey and/or deny selected information and indicators to selected audiences to influence their emotions, motives, and objective reasoning, and to intelligence systems and leaders at all levels to influence official estimates, assumptions, and suppositions. This type of manipulation can result in out-of-place behaviors and official actions favorable to the originator's objectives. In various ways, perception management combines truth projection, operations security, cover and deception, and psychological operations. Such weapons do not seek to affect the information system itself but rather the behavior of the users, thus influencing their decisions. As an example, the current state of voice synthesis would allow for the cloning of a person's voice. The propaganda value of broadcasting a synthesized message to a selected audience is enormous. This is not a far-fetched scenario when you consider the fact that we currently have the ability to control the broadcast of foreign radio and television transmissions using existing equipment presently in orbit. "Spoofing" other people's identity, selective spanning, broadcasting specific arguments and discourses, misinformation, slogans, and information overload can influence decision-makers to a point where they misinterpret what is happening. Humans have been employing this strategy for centuries before the introduction of networked systems. Now, however, this strategy takes on a whole new dimension. Trying to recreate a close representation of what exactly is happening in the real world is the most difficult part of conflict management and warfare; and these considerations will become more and more central to the Information Warfare debate.

Semantic weapons influence a system's "behavior space." This term, which is central to information warfare, may be thought of as any sequence of states within a system. The system may then follow the set of paths the system is capable of taking. A behavior space can be represented graphically, and/or abstractly, and often presents itself within many dimensions. The behavior space depicts what a system can do, so that what it actually does can be seen as a special case determined by initial conditions, circumstances, purposes, and so forth. This is quite a challenge to understand, but this is the newest dimension of what was once referred to as psychological operation and deception.

The whole notion of controlling a behavior space is based on the idea that a system is constituted by communication among observers who participate within that system by drawing distinctions and creating relations within it (i.e., second-order cybernetics, which involves the observer as a constitutive part of a circular organization and is concerned with phenomena such as self-reference, epistemology, autonomy, self-government, or autopoiesis). This contrasts sharply with the use of the same term in the structural-functional school of sociology, where it denotes a pattern of social acts in pursuit of individual and collective goals and is governed by the need of the social system to maintain its own structure. In cybernetics, analysis refers to the limiting process in a system involving an observer and the observed. The "observer" draws distinctions that the "observed" opposes or violates forcing the "observer" to relate the distinguished parts until a stable description of the system involving the "observer" emerges. In a cybernetic analysis, the whole is described not merely in terms of its parts but most significantly by the pattern that connects them. Such an analysis reveals the holistic properties of a system without loss or destruction. This is important because in the not-so-distant future, multimedia information system environments will become the principal information management tools. Requirements for information rise and fall throughout the specific phases of a crisis. Today, military operations typically require decision-makers to rely even more on automated processes (to search, retrieve, collate, and present information during the crucial information-intensive phase of a crisis). The danger (or opportunity) is that the "dramatic orchestration" of what we believe as objective information is always grounded in a specific point of view and therefore open to manipulation.

One example of this can be seen in the international "serialization," of the Zapatistas' uprising in Chiapas, Mexico. This Internet "soap opera" has been extremely effective in generating support for the Zapatista rebels throughout Mexico and the rest of the world. Despite the fact that a great deal of what is carried on the Internet can be seen as misinformation, it has nonetheless sparked a worldwide discussion on the meaning and implications of the rebellion. Whatever the ultimate outcome of the unrest, it cannot be denied that the Internet completely changed the political equation in Mexico. That they succeeded was evidenced in March 1995 when thousands marched in Mexico City to protest the Zedillo Administration's arrest warrant for Subcommander Marcos. Rebel supporters around the world followed developments by reading Zapatista communiqués on the Internet. Precisely because of their de-centralization, the Internet warriors don't have the ability to take national power. Still, they are a growing political force which could make the country ungovernable. And their lack of any central authority makes them far less vulnerable to co-optation or repression. (Joel Simon, news analysis, Pacific News Service, 20 March, 1995.)

29. Even though there may be reason to believe that economic pressures will force unprecedented levels of interactivity, interconnection will inevitably result in a

period of cross-cultural interplay, which will inevitably set the stage for societal, religious, and ideological conflict.

30. GAO Executive Report B-266140, 1996.

31. Committee on Information Systems Trustworthiness, *Trust in Cyberspace*.

32. Rasch, "Criminal Law and the Internet."

33. *Redefining Security: A Report to the Secretary of Defense and the Director of Central Intelligence* (Washington, D.C.: Joint Security Commission, 28 February 1994).

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ARCHITECTURE AND EXPECTATIONS: NETWORKS OF THE WORLD—UNITE!

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THE INTERNET IN THE OTHER THREE-QUARTERS OF THE WORLD

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BUSINESS ON THE NET: A PRIMER ON THE NEW REALITIES

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HOW WILL WORK CHANGE? E-LANCERS, EMPOWERMENT, AND GUILDS

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CYBERCRIME, CYBERTERRORISM, AND NETWORK WARFARE: THE NEXT GENERATION OF CONCERNS FOR USERS OF NETWORKED INFORMATION SYSTEMS
Col. John M. Fabry

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